Division of Aquatic and Wildlife Resources

Guam Department of Agriculture

Annual Report Fiscal Year 1995

Guam
Aquatic
and
Wildlife
Resources
Annual
Report
FY'95

ANNUAL REPORT
FISCAL YEAR 1995

DIVISION OF AQUATIC AND WILDLIFE RESOURCES
Rufo J. Lujan, Chief

GUAM DEPARTMENT OF AGRICULTURE
Michael W. Kuhlmann, Director

Edited by:

Robert D. Anderson
Gerald W. Davis
Todd J. Pitlik
Gary J. Wiles

PERIOD COVERED:
October 1, 1994 to September 30, 1995

Guam Aquatic and Wildlife Resources Annual Report FY 195

ACKNOWLEDGEMENTS

The Division of Aquatic and Wildlife Resources, Department of Agriculture, wishes to acknowledge the following persons and organizations for their assistance in our work:

Members of the Guam Fishing & Boating Association, the Marianas Fishing Derby Committee and the Manager of the Guam Fishermens's Coop for allowing fishery biologists to examine their fish;

Fishermen who have cooperated with fishery data collection;

Individuals who have reported poaching activities and bird sightings;

Hunters who have cooperated with wildlife data collection by filling out and returning hunter questionnaires;

Base Commanders of the U.S. Naval Magazine, Naval Station, Naval Computer and Telecommunications Master Station, and Andersen Air Force Base;

Security Officers and their staffs at the U.S. Naval Magazine, Naval Computer and Telecommunications Master Station, and Andersen Air Force Base;

Staff and management of KGTF Channel 12;

Print and electronic media for coverage of our programs and activities and for their support of conservation education programs;

Personnel of the Naval Oceanographic Command Detachment, U.S. Naval Air Station, Guam, for providing weather data;

The Marine Lab, University of Guam;

Personnel from the Office of Enforcement, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce;

Personnel from the Division of Law Enforcement, U.S. Fish and Wildlife Service, U.S. Department of the Interior.

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JOB PROGRESS REPORT
COORDINATION PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-3C-3
SUB-PROJECT NO.: C-1
JOB NO.: 1

JOB TITLE: Coordination of Guam's Fish and Wildlife Programs (1630, 2630)

PERIOD COVERED: October 1, 1994 to September 30, 1995

OBJECTIVES

To plan, coordinate, supervise, and administer all fish and wildlife restoration and endangered species programs.

PROCEDURES

1. Supervise the planning and documentation of the Fish and Wildlife programs.

2. Administer all fiscal and budgetary matters and coordinate with the Central Accounting and Budget Office.

3. Administer all personnel matters including recruitment of off-island staff.

4. Represent the Division and Department of Agriculture in all matters pertaining to Fish and Wildlife Resources.

RESULTS

The Division experienced several staff changes during the year, and has suffered a net loss of staff:

Administration: Division Chief Rufo J. Lujan and Administrative Officer Janet C. Blas retired at the end of the segment. Secretary I (Typist) Judith Diaz transfered to another Department.

Wildlife: Wildlife Technician II Jesse Guerrero took a one-year leave without pay to continue his education. Wildlife Biological Aide Mary Taylor retired at the end of the segment.

Fisheries: Biologist III Robert F. Myers retired at the end of the segment. Georgette Concepcion was promoted to Fisheries Biologist II and transferred from the locally funded Technical Assistance Program to Fisheries, where she will be responsible for freshwater biology.

Law Enforcement: At the end of the reporting period there were four positions for Conservation Officer I vacant.

Division staff spent the first quarter preparing the annual Job Progress Reports on the research and other activities conducted during FY94 under its various federal programs and submitted them to the U.S. Fish and Wildlife Service Regional Office.

Staff also devoted considerable effort to preparing the Federal Aid project documentation necessary to obligate funds for the Division's various programs during FY96. This documentation included annual Grant Agreements for 1) Project FW-3C, Guam Fish and Wildlife Coordination, which covers the administration and coordination of the Division's Federal Aid programs and which is jointly funded by wildlife (PR) and sport fisheries (DJ) funds; 2) Project F-1R, Guam Sport Fish Investigations, which covers sport fish research and survey activity and which is funded with sport fisheries (DJ) funding; and 3) Project W-1R, Guam Wildlife Investigations, which covers wildlife research and survey activity and which is funded with wildlife (PR) funds. In addition, annual Grant Agreements and Amendments were prepared for the Division's various Fisheries Development and Endangered Species Investigations (Section 6) projects.

The Division's funding proposal for the allocation of FY95 Section 6 Endangered Species Conservation Program grant funds was approved by the Fish and Wildlife Service, albeit at a significantly lower level than requested, yet more than previously allocated. In early March, staff successfully responded to an urgent need to amend the existing Application for Federal Assistance (now Grant Proposal) to extend it for an additional year, and to submit a Grant Agreement obligating the FY95 funds immediately, to extend through the end of FY96, in order that a Congressional threat to rescind all unobligated Section 6 funds be averted. Considerable effort was invested into preparing a revised Section 6 proposal that included a request to amend the Division's Endangered Species Sub-permit to allow for the translocation of a limited amount of genetic material (Mariana crow eggs and/or chicks) from Rota to Guam. The permit request was still pending at the end of the segment.

The Division Chief and his staff represented the Division and the Department of Agriculture in all matters relating to fish and wildlife resources. This frequently entailed meetings with other agencies of the Government of Guam, various Federal agencies, and the military.

The Division's administration and coordination responsibilities are 50% funded by local funds.

The Chief served on the Department's Land Lease Approving Committee, which must review and approve all proposed leases of government land for agricultural purposes. He also served as a member of the Territorial Land Use Commission. The Chief is also a member of the Area Committee for Oil Spill Response. In addition, he served as a member of the Criminal Justice Advisory Committee at Guam Community College.

The incoming administration accepted the Division Chief's courtesy resignation from the Territorial Land Use Commission. They also replaced him as Guam's representative to the Western Pacific Regional Fisheries Management Council.

The Assistant Chief continued to serve as a member of the Technical Advisory Committee for the I Tano'ta land use plan being developed by the Territorial Planning Council. He also served as a member of the Technical Review Committee for the Andersen Air Force Base Institution Restoration Program (IRP) as well as for various Navy IRP's.

The Assistant Chief supervised the locally-funded Technical Assistance Program, staffed by Biologist II Marvin Aguilar.

The Division Chief, Assistant Chief, and Wildlife Supervisor attended the Legislative public hearing on the renewal of the Guam Endangered Species List with the Director, to provide support for the renewal.

The Division participated in a series of meetings with the Department of Parks and Receation, the Chamorro Land Trust Board, and the Bureau of Planning to review the inventory of Government of Guam lands to determine which have the best potential for incorporation into the Territorial Park System as Conservation Areas in accordance with the mandate of PL 22-18, which requires that the two Departments (Agriculture and Parks) develop a comprehensive masterplan before any additional lands are so designated.

The Assistant Chief, Fisheries Supervisor, and Wildlife Supervisor serve as members of the Area Committee's Oiled Wildlife Cleanup Subcommittee, which was established to review current cleanup techniques for inclusion in the Area Plan. The subcommittee recognized the need for specialized training in wildlife rehabilitation and appealed to the Coast Guard for assistance in obtaining the necessary training for Guam. The Coast Guard was able to identify a source of funding to support the needed training and the International Bird Rescue Research Center in Berkeley, California was contracted to provide it. In addition, the Coast Guard was able to purchase the needed supplies and materials to support the training.

The subcommittee selected the full three-day Oiled Wildlife Rehabilitation Trainers Course offered by IBRRC, because it felt that this may be a one time only opportunity for such training and it would be best to train persons locally to themselves be able to provide training to volunteers and others in the future. The course was scheduled for mid-February 1995 in order that it could be completed prior to an exercise scheduled for March 23.

The Wildlife Rehabilitation workshop included hands-on work with live ducks and ended with a scenario-based tabletop exercise that enabled the workshop participants to put the training that they had just received into practice. The consensus opinion of the participants in the four days of training was that the IBRRC trainers did an excellent job of presenting the material and that the workshop greatly increased the capability of Guam to handle a significant oiled wildlife incident.

Because the Occupational Safety and Health Administration requires a certain level of hazardous materials training for all persons involved in an oil spill response, the Coast Guard also was able to arrange for a contingent from the Pacific Strike Team to present 8 hours of HAZMAT training the day prior to the beginning of the oiled wildlife rehabilitation course. A group of 28 persons from the Division of Aquatic and Wildlife Resources (including both Fisheries and Wildlife staff), the Guam Environmental Protection Agency, the Guam Department of Commerce, the University of Guam Marine Laboratory, the U.S. Coast Guard, the U.S. Fish and Wildlife Service, the Marianas Audubon Society, and Guam Animals in Need attended the four days of training. In addition to that training, the Guam Environmental was able to arrange for a 40-hour Hazardous Waste Operations (HAZWOPER) course held in early July. Eight slots were allocated to the Division, ensuring that a significant number of Division staff will have had the necessary training should a spill involving fish and wildlife resources occur.

The Assistant Chief was requested to provide presentations on oiled wildlife recovery to two sessions of an oil spill response training program conducted for members of the oil industry by Guam Response Services Limited. This training, conducted by consultants, was to help prepare industry mid-level supervisory staff to handle response to an oil spill, both in real life and in a scheduled oil spill exercise.

The Assistant Chief served as a member of the design team for an oil spill exercise intended to exercise the Guam Area Plan. This exercise, named Prutehi I Tasi, was one of those required under the Oil Pollution Act of 1990, and was the first industry sponsored such exercise. Other members of the design team included representatives of the Coast Guard, Guam EPA, a consultant for Guam Response Services Limited, and a consultant for USEPA. The exercise, held March 23, was preceded by two Area Committee meetings at which training in the Unified Command System was given, and a third Area Committee meeting at which a tabletop exercise was conducted to help prepare both agency and industry personnel for the drill. After the exercise, significant effort was made to evaluate of the Prutehi I Tasi oil spill exercise and prepare the after-action report.

In a revision of the Area Plan, the Area Committee was restructured. The Oiled Wildlife Subcommittee merged into the Operations Subcommittee, and a new Planning Subcommittee was formed. The Assistant Chief was reassigned to the Planning Subcommittee, while the Fisheries and Wildlife Supervisors remained attached to the Operations Subcommittee. The subcommittee has continued to meet to develop an oiled wildlife response capability, including evaluation of potential facilities for conducting long-term rehabilitation.

The Assistant Chief attended a meeting of the parties to a brown tree snake Memorandum of Agreement (USDI, USDA, DOD, State of Hawaii, and the Government of Guam) held on February 23 and 24, 1995 at COMNAVMAR. This meeting was sponsored by the Navy and was intended to review on-going brown tree snake work being funded by the Department of Defense, to review the brown tree snake control/interdiction program implemented as a part of Operation Tandem Thrust, and to develop a BTS Control/Interdiction Plan for Military Training Exercises. A draft plan was reviewed and revised.

The Division Chief and the Assistant Chief were jointly appointed as members of the Navy's Rehabilitation Advisory Board for installations other than Naval Air Station.

Biologist III Celestino Aguon and Biologist III Gary Wiles were appointed to the Pacific Insular Recovery Team and Biologist III Kelly Brock was appointed as a member of the Captive Breeding Working Group, sponsored by the U.S. Fish and Wildlife Service.

Division staff made a number of off-island trips related to Federal Aid programs:

The Division Chief attended a meeting of the parties to a brown tree snake Memorandum of Agreement (USDI, USDA, DOD, State of Hawaii, and the Government of Guam) held on October 13 in Honolulu. He also attended the 85th meeting of the Western Pacific Regional Fishery Management Council in Honolulu November 7-9. In December he returned to Honolulu to attend the American Flag Pacific Islands Coral Reef Management Initiative Planning Meetings, held December 5-7. This was followed by attendance at the Brown Tree Snake Control Committee Meeting on December 13-14.

The Chief and Assistant Chief attended the 1993 Federal Aid Coordinators Conference held in Monterey, California in October 1993. After that conference, they traveled to Portland, Oregon where they met with the new Regional Director of the Fish and Wildlife Service.

Fisheries Supervisor Gerald W. Davis attended the Aquatic Resources Education Conference in San Diego, California in July 1995.

Biologist III Andrew Torres attended a South Pacific Commission funded Sub-Regional FAD (Fish Aggregating Device) Skills Workshop in Palau October 12-November 4.

Biologist III Andrew Torres attended the Bottomfish Plan Monitoring Team meeting in Honolulu, Hawaii in April 1995, funded by the Western Pacific Regional Fisheries Management Council.

Fisheries Biologist III Robert F. Myers attended the Pelagic Plan Monitoring Team meeting in Honolulu in April, 1995, funded by the Western Pacific Regional Fisheries Management Council.

Fisheries Biologist III Todd Pitlik attended a South Pacific Commission/Forum Fisheries Agency workshop on management of inshore fisheries resources in Noumea, New Caledonia June 26-July 7, funded by the South Pacific Commission.

Biologist III Kelly Brock, Wildlife Biologist II Grant Beauprez, Technician II Robert Cruz, and Biological Aide Franklin Cruz made numerous trips to Rota in support of the Rota Rail Introduction Project. In addition to releasing a total of 60 birds on three separate occasions, they conducted rodent and predator trapping and radio telemetry monitoring of released rails.

Biologist III Kelly Brock attended a meeting of the Captive Propagation Working Group at Olinda, Maui in November.

Biologist III Celestino Aguon and Biologist III Gary Wiles participated in the second meeting of the Pacific Insular Recovery Team on Rota in January 1995.

Biologist III Gary Wiles participated in bat surveys in the Commonwealth of the Northern Mariana Islands, making two trips to Aguiguan and one trip to Anatahan to conduct field surveys, followed by a trip to Saipan to participate in data analysis and preparation of a report.

Wildlife Section staff and the Assistant Chief participated in the meeting of the Pacific Avifauna Recovery Coordinating Committee which was held on Guam in January.

The Division hosted a number of off-island visitors during the year.

PROGRAM COST

The estimated cost of the Coordination/Administration project is $65,000.

Report prepared by: Robert D. Anderson

JOB PROGRESS REPORT
INFORMATION/EDUCATION PROGRAM

STATE: Territory of Guam

PROJECT NO.: FW-3C-3
SUB-PROJECT NO.: C-3
JOB NO.: 1

JOB TITLE: Public Information and Education on Guam's Fish and Wildlife Restoration and Endangered Species Programs (2520, 2530, 1630)

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

The loss of a much-needed staff to assist in conservation education and the possibility of a partnership with a "giant" in the fast-food industry mark this year's Public Awareness and Conservation Education (PACE) Program.

In November of 1994, the Division of Aquatic and Wildlife Resources (DAWR) lost the services of a Management Analyst III, a locally-funded position recruited on a limited-term basis primarily to assist the PACE effort. As a result, the number of students covered by the program was significantly reduced. By comparison, there were 3,061 students visited in FY95 as opposed to 8,900 students in FY94, a decrease of almost 66%. When compared, however, to the number of students covered in FY93 (prior to the recruitment of the MAIII), this year's total reflects an increase of nearly 25% over the 2,459 students covered in FY93.

Two, two-day marine fishing derbies, one in October and one in June, were conducted at Sirena Beach on Andersen Air Force Base for kids ages 7 through 12. Each event was preceded by a fishing clinic. Following the first derby, the quota of participants was increased after the Division determined that Sirena Beach was spacious enough to safely accommodate more than 100 anglers. Moreover, previous derbies have always resulted in a percentage of registered participants not showing up for some reason or another on derby day.

Along this line, the Division has approached officials of Burger King, a pioneer contributor since the derby project was initiated in 1990, about the possibility of co-sponsoring the event in terms of promoting and furnishing prizes and refreshments. The Division's involvement would be confined to technical assistance and supervision of the event itself. At this writing, a proposal is being drafted by staff for review by the management of Burger King. The Division is optimistic that local Burger King officials will become a partner in future derbies.

The 30-minute Coral Reef educational video, targeted for completion during this fiscal year, has been delayed due to technical problems. The project, however, will be completed during the new fiscal year.

The Division completed the distribution of 3,200 sets of flyers to all public and private elementary, middle and high school classrooms, libraries, museums and other educational institutions and organizations. Also completed and currently in circulation are 30,000 Mariana fruit bat posters.
The Division transferred custody of wildlife specimens and bird mounts to the Guam Museum for public display at the Tumon satellite museum. The items transferred would compliment a green sea

turtle shell and a Mariana fruitbat skin which were transferred last fiscal year to the main Museum at Adelup.

The Division continues to issue press releases on its projects and activities, distribute resource education materials, set up static public displays, submit feature articles to the print media, make radio and television appearances and facilitate requests for information from students and members of the general public.

BACKGROUND

The PACE program was established in conjunction with the Division's mission to protect, preserve, develop and enhance Guam's aquatic and wildlife resources. The program consists of school presentations dealing with aquatic and wildlife conservation, kids' fishing derbies, the production of resource materials for classroom use including coloring books, activity guides, posters and informational flyers, news releases, static public displays, public service announcements, scheduled television and radio appearances, press conferences and feature articles.

Up until FY90, the program was facilitated primarily by a Public Information Officer (PIO), and periodically, by staff biologists. Since then however, Conservation Officers (COs) have become active participants in the PACE effort addressing the enforcement aspects of resource conservation. As a result, the Division has been able to cover nearly twice as many classrooms.

In recognition of the need for additional staff to assist in the PACE effort, a Management Analyst III was recruited in November 1993 on a one-year employment basis to concentrate primarily on school presentations (MAIII expired in November 1994). To better meet the needs of the PACE program, a proposal to establish a Resource Education Specialist I, II, III and IV series was submitted to the Civil Service Commission for consideration.

The effectiveness of DAWR's PACE programs and activities can best be measured by the ever-increasing demand by teachers and students for fish and wildlife presentations, the community's continuing response in reporting suspected poachers and poaching activities to COs and police, and the many requests for resource conservation materials. As in the past, residents continue to report bird sightings, bring in injured birds or birds presumed to be endangered species, and generally to encourage the institution of more intensive management programs for Guam's fish and wildlife resources.

PROCEDURES AND RESULTS

Division activities and efforts included:

1. Class presentations on endangered species, coral reef ecology and general information on fish and wildlife conservation and enforcement. Division staff visited 3061 students throughout the school year and during the summer. Of this number, 2096 were elementary school students, 235 middle and high school students, 295 University of Guam students, and 435 summer campers.

2. Two Kids' fishing derbies, each preceded by a fishing clinic open to the public, were held October 22 and 23, 1994 and June 17 and 18, 1995 at Sirena Beach on Andersen Air Force Base. Sixty-four of the 100 participants fished at the October derby while nearly 100 of the 150 slots available were filled for the June derby. The Division has increased the original quota of 100 anglers or 50 per derby to 150, or 75 kids each day. (See Appendix 2, Inshore Report).

3. The distribution to schools, libraries, and other institutions, of 3,200 sets of flyers, each set consisting of color pictures and accounts on 84 of Guam's marine and terrestrial vertebrates, invertebrates and habitats. The flyers were produced by the Division and printed with funds from the Bureau of Planning's (BOP) Coastal Management Program.

4. The development and completion of Mariana fruit bat *(Pteropus mariannus)* posters, a joint project between the Division and the BOP's Coastal Management Program. Posters are currently being circulated to schools, libraries, and other institutions and are available to the general public upon request.

5. Production of a 30-minute coral reef video was initiated in cooperation with the University of Guam Marine Laboratory. The program was scripted, video shot, and major editing has been completed. Upon completion of final editing, the video will be reproduced and circulated for educational use.

6. Erection of static displays at the Micronesia Mall and the U. S. Naval for Earth Week, Crime Stoppers Month, Andersen Air Force Base Air Show, Community College Week, Farmers Appreciation Month and University of Guam Charter Day. An estimated 25,000 to 30,000 residents viewed the displays. The endangered wildlife display at the A. B. Won Pat International Airport, a joint project of the Division and the U. S. Fish and Wildlife Service (USFWS), was finally completed with the arrival of display boards. Ms. Glenda Franich from the EPIC Division, Portland, Oregon arrived on island to put the finishing touches to the display.

7. Participation at six public hearings on proposed revisions to Guam's fishing regulations and one public hearing on proposed revisions to Guam's hunting regulations.

8. Appearances on local radio and television talk shows on illegal fishing methods, promotion of kids fishing derbies and general discussion of fishing and hunting activities and enforcement.

9. Serving as judges for science fairs at Cathedral Grade School, Carbullido Elementary School, Dededo Middle School and F. B. Leon Guerrero Middle School. In addition, staff participated as guest speakers during Career Day throughout Guam's high schools.

10. Development of newspaper and television articles on Guam rail, Micronesian kingfisher and Mariana crow recovery efforts, brown tree snake and hunting, fishing and enforcement activities.

11. Rendering assistance to off-island media or agencies which visited Guam to do feature stories on the island's natural resources; among them a Hawaii-based interactive science program called "Waterwatch" which conducted extensive interviews with Division staff and officials from the Guam Environmental Protection Agency on Guam's surface and underground water sources, the human impacts on such sources and endangered species which live on wetlands. The four-part series is scheduled for broadcast next year.

12. Development of press releases, feature articles and media conferences focusing on status and progress of DAWR programs and activities;

13. Administrative duties as assigned by the Division Chief and/or Assistant Chief.

RECOMMENDATIONS

1. Complete the production of a 30-minute video coral reef ecology for use in and enhancement of fisheries presentations, and for distribution to school classrooms, libraries, museums and other educational institutions.

2. Pursue the establishment and recruitment of a locally-funded Resource Information and Education Specialist or a federally-funded Aquatic Education Specialist. The establishment of the latter will signal the first step towards implementation of the Aquatic Education Leadership Workshop for public and private school teachers.

3. Pursue the development of a partnership between the Division and Burger King of Guam in kids' fishing derby events, both marine and freshwater.

4. Develop a 30-minute educational video on endangered native species and wildlife conservation in general, for use in and enhancement of class presentations.

5. Encourage and support the creation of and actively participate in the activities of an environmental education/information network.

6. Respond affirmatively to public requests for a freshwater derby for older youths ages 13 through 17 and a similar event for adults. The marine and Fena Lake fishing derbies, which were begun in FY'91 to promote fishing as a form of recreation and to instill a conservation ethic among school-age children, have resulted in suggestions for similar derbies for older youths and adults.

7. Continue aquatic and wildlife presentations at public and private schools, libraries, summer camps, after-school programs and other organizations.

8. Continue public awareness program through slide shows, press releases, news articles, press conferences, public hearings and other media to keep the public apprised of the progress and accomplishments of the Division's fish, wildlife and endangered species programs.

9. Secure funding for the erection of interpretive signs at major beaches throughout Guam and other sites frequently victimized by coral and fishing violators.

10. Update and develop new PSAs for television and radio.

11. Coordinate the Division's participation in mutual programs and projects with Bureau of Planning's Coastal Management Program, the Department of Education, the University of Guam Extension Service, Department of Parks and Recreation, the Guam Environmental Protection Agency, the U. S. Fish and Wildlife Service, the National Park Service, the Guam National Wildlife Refuge and Sea Grant.

PROGRAM COST:

The estimated cost of the Division's PACE Program is $75,442.

Report prepared by: Lillian L. Mariano

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: F-1R-3
SUB-PROJECT NO.: F-1
STUDY NO.: 1
JOB NO.: 1

STUDY 1: Fisheries Participation, Effort, and Harvest Surveys (2430)

JOB TITLE: Offshore Fisheries Surveys

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

Monthly offshore fisheries surveys were conducted at the Agana Boat Basin, the Agat Marina, and the Merizo Boat Ramp from October 1994 through September 1995. The Project Coordinator for this project retired on September 30, 1995. The data for this project will be analyzed once the vacant position is filled and the contract to design a computer program to analyze the offshore data has been awarded. Analytical results will be reported in the next segment.

OBJECTIVES

To establish baseline catch and effort data for reef fish, bottomfish, and pelagic species necessary to develop a fisheries management plan for Guam and to gather limited biological data on these fisheries.

PROCEDURES

During FY95, interviews of returning offshore fishing parties were conducted at the Agana Boat Basin, the Agat Marina, and the Merizo Boat Ramp. The Agana Boat Basin is surveyed four days a month; two of these days were randomly selected weekdays and two were randomly selected weekend days. Each survey consisted of two periods, one from 0500 to 1200 hours and the other from 1600 to 2400 hours. The southern launching sites at the Agat Marina and the Merizo Boat Ramp were surveyed by randomly selecting one weekday and one weekend a month for each site. The survey periods for the Agat Marina were 0530 to 1200 and 1600 to 2400, while the survey periods for the Merizo Boat Ramp were 0600 to 1200 and 1600 to 2400. Island-wide participation was determined by means of a morning and evening survey of all public boat launching areas in which all trailers attached to vehicles were counted, but no interviews were taken. This assumes that the ratio of boat trips participating in fishing as opposed to boat trips not participating in fishing, and the proportion of boats engaging in each method for boats utilizing the Agana Boat Basin is representative of the island as a whole.

RESULTS

Data collected from offshore surveys have been coded and filed. However, the project coordinator retired on September 30, 1995. A contract to design a computer program to

analyze the offshore data should be awarded during FY96. Analytical results will be reported in the next segment.

PROJECT COST

The cost of this project for this fiscal year is $115,000.

RECOMMENDATIONS

The FY95 Offshore Report lacks analysis of the data collected. During FY96, a biologist must be recruited to activate the analysis and reporting portions of this project. A contract to design a computer program to analyze the offshore data should be awarded during FY96.

Report prepared by: Thomas Flores, Jr.

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: F-1R-3
SUB-PROJECT NO.: F-1
JOB NO.: 2

STUDY 1: Fisheries Participation, Effort, and Harvest Surveys (2430)

JOB TITLE: Inshore Fisheries Survey

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

Monthly inshore fisheries surveys were conducted along Guam's shoreline from October, 1994 to September, 1995. The total estimated inshore fisheries catch for this time period was 39.5 mt (metric tonnes), 93% of which were finfish (excluding mañåhak). Hook and line was the most practiced method accounting for 64% of the total participation (excluding seasonal fisheries data) or 37,062 participants. In terms of catch rate, other methods was the most successful of all the daytime methods, yielding approximately 4.77 kg/gear-hour (gh) and a harvest of 0.47 mt, and spearfishing with scuba gear was the most successful nighttime fishing method, yielding approximately 5.02 kg/gh and a harvest of 0.71 mt. Hook and line was the most successful method in terms of the overall finfish catch, yielding approximately 0.11 kg/gh and a harvest of 14.0 mt. The seasonal mañåhak and achenchon run did not occur in FY95.

Aerial Survey

The Aerial Survey report is included in Appendix 1.

Kid's Fishing Derbies

The Kid's Fishing Derby report is included in Appendix 2.

BACKGROUND

Effective management of Guam's inshore fishery resources requires accumulating data on the types of fishing methods used, fishing pressure, and annual catch. In order to identify trends in fishing participation, effort, and catch, the Division of Aquatics and Wildlife Resources (DAWR) has been monitoring marine fishing activities since the early 1960's. Over this period of time, survey and analysis methodologies have changed in response to fluctuations in budget and staff. In the last several years, however, field survey techniques have been expanded and refined, while estimates of Guam's recreational / subsistence fishing activities have come to be based on more reliable data analysis techniques.

OBJECTIVES

1. To establish baseline catch and effort data for reef fish species necessary to develop a fisheries management plan for Guam.

2. To gather limited biological data on Guam's fisheries for management purposes.

PROCEDURES

During FY95, four "inshore-catch" survey days were selected per month. Fishermen-intercept interviews were conducted to determine amount of effort, fishing method, location, reef zone, species composition, and total actual, calculated, or estimated weight (kg) of fish caught for both day and night fishing. The day survey covered a six-hour interval (beginning at 0630h) and the night survey covered a five-hour interval (beginning at dusk or 1900h). Only one of three survey regions (Figure 1) was selected for each "inshore-catch" day and fisheries data collection was restricted to that region. However, because of infrequently interviewed methods, e.g., drag netting, representative samples were sometimes difficult to obtain. Therefore, if a particular fishing method was not observed within the selected survey area during the survey, one or both of the other two areas could be surveyed for those methods.

During FY95, day and night "inshore-participation" surveys were conducted on four randomly selected days per month, which did not occur on the same days as the "inshore-catch" surveys. These surveys entailed making visual observations of fishing participation within readily accessible portions of Guam's coastline (Fig. 1, locations: 1-35, 40-45, 50, 52-57, 60-72). Based on data collected during nine non-consecutive years of "inshore-aerial" surveys conducted between FY63 and FY79, approximately 85% of Guam's inshore fishing activities were known to occur within this area. Fishing effort data was collected by instantaneous spot checks (one-way direction without backtracking) around the island and the route was alternated each survey from a "clockwise" to "counterclockwise" direction from a randomly selected area number (Fig. 2). Since the participation survey included both day and night fishing, start times began at 0630h and 1900h and ended once the entire island circuit had been completed.

Because the coastal fishing participation and range has steadily increased over recent years, "inshore-aerial" surveys were reinstated around Guam during FY90 in order to update island-wide participation estimates. Aerial surveys for this reporting period were begun in October 1994 and conducted twice monthly. The surveys were performed on regularly scheduled participation days (one weekday / weekend) and start times were moved up one hour for each subsequent survey (0800-1200h) and repeated after reaching 1200h. Visual observations of areas not covered in the "inshore-participation" survey (Fig. 1, locations: 36-39, 46-49, 51, 58, 59, and 73-92) included fishing effort data. The first weekday and weekend participation dates were routinely selected as the initial aerial dates due to the possibility of cancellation, e.g., poor weather conditions.

The aerial survey methods were sorted by method. A ratio of participants observed in areas outside the inshore participation route were compared to the total number of observations for the island. The resultant P_2 value provides a variable (%) that can be used to expand inshore participation values to island-wide participation values.

Seasonal data on the scad mackerel (atulai), goatfish (ti'ao), and jacks (i'e') were acquired through actual participation and catch surveys. Species of fish that seasonally recruit *en masse* on Guam's reefs, i.e., juveniles of rabbitfish (mañåhak), and fusiliers (achenchon) events can be predicted based on the lunar cycle and may occur the day of and days following the fourth, fifth, and tenth last quarter moons preceded by the first complete lunar cycle of the calendar year. Mañåhak recruit into inshore areas in order to begin feeding on macroalgae (lumot).

Figure 1. Inshore Fisheries "Participation Survey" Route and Location Codes.

Achenchon recruitments have been highly significant in terms of catch and a large portion of the annual catch when they occur. In addition, they usually run with ti'ao and have occurred the same time as mañåhak. Atulai enter protected areas, especially the Agana Boat Basin, Apra Harbor, and Inarajan Bay, at various times during the year and make up a significant portion of the annual catch when they occur.

Ti'ao and i'e' recruit in large masses as the previously mentioned species, but are more predictable and usually last several weeks to months at a time. Past recruitment events of these species have shown to be highly significant in terms of total catch, especially *Caranx* spp. with hook and line and *Mulloides flavolineatus* and *M. vanicolensis* with cast net, when they occur.

The FY95 inshore harvest estimates were statistically expanded by a computer software package for Macintosh known as the 4th Dimension database program (4D). The 4D program utilizes formulae described in the FY83 report (Project FW-2R-20, Sub-Project F, Study F-1, Job 2) to compile and expand inshore survey data for the fiscal year.

RESULTS

During FY95, the estimated inshore harvest for day, night, and seasonal fishing around Guam was 39.5 mt. Finfish accounted for 93% of total harvest or 36.7 mt (excluding

mañåhak). The seasonal mañåhak and achenchon run did not occur in FY95. The total inshore catch (finfish and invertebrates, excluding mañåhak) resulted from a total effort of 186,057 person-hours (ph) and 171,249 gear-hours (gh). Overall, approximately 0.23 kg/gh of fish were harvested.

CATCH

Hook and line yielded the largest overall catch with 14.0 mt or 38% of the total harvest. Spearfishing with snorkel gear was second with 8.5 mt or 23%, while gill netting was third with 7.7 mt or 21%, and cast netting was fourth with 5.4 mt or 15% of the total harvest (Table 1).

Table 1. Combined estimated inshore participation, effort, and total harvest (kg) for all methods during the day and night in FY95.

METHOD	Persons	Gears	Trips	Per-Hrs	Gear-Hrs	Catch	Finfish	Inverts	CPUE†
Hook & Line	37,062	38,880	21,987	119,606	125,383	14,095	14,021	74	0.21 wd
Cast Net	6,894	6,011	5,315	18,819	16,491	5,411	5,411	0	0.93 wen
Gill Net	7,912	3,694	2,782	32,154	15,255	8,278	7,651	628	0.82 wd
Surround Net	896	347	347	2,901	1,102	346	346	0	0.52 wed
Spear Snorkel	3,600	3,569	1,515	9,410	9,298	9,249	8,453	796	1.46 wn
Spear Scuba	290	284	114	284	276	711	702	9	5.02 wn
Drag Net	125	30	30	195	46	75	75	0	3.47 wn
Hooks & Gaffs	760	1,055	500	1,802	2,512	699	0	699	1.13 wd
Other††	584	584	476	886	886	664	24	640	4.77 wed
TOTAL	58,123	54,454	33,066	186,057	171,249	39,529	36,683	2,846	0.23

†CPUE summary derives the greatest weekday (wd), weeknight (wn), weekend day (wed), and weekend night (wen) values from Tables 2 and 3. The greatest CPUE value for hook and line was in region 3.
††Other Methods usually include: gleaning, hand nets, traps, and spears.

The top three daytime methods accounted for approximately 90% of the daytime total and 62% of the combined total harvest (Table 2). Hook and line fishing accounted for the most fish with 11.8 mt or 47% of the day harvest. Gill netting was second with 5.6 mt or 22%, while cast netting was third with 5.4 mt or 21%, and spearfishing with snorkel gear was fourth with 1.5 mt or 6% of the total day harvest.

The top three nighttime methods accounted for approximately 93% of the night total and 31% of the combined total harvest (Table 3). Spearfishing with snorkel gear accounted for the most fish caught with 6.9 mt or 58% of the total night harvest and hook and line fishing was second with 2.2 mt or 18%. Gill netting was third with 2.0 mt or 17% and spearfishing with scuba gear was fourth with 0.7 mt or 6% of the total night harvest.

EFFORT

Hook and line fishing was the most practiced fishing method based on the total participation (Table 1), accounting for 37,062 persons or approximately 64% of the total participation. Gill netting was the second most practiced method overall accounting for 7,912 participants or 14% of the total participation, while cast netting followed in third with 6,894 participants or 12% of the total participation.

Table 2. Combined estimated inshore participation, effort, and total harvest (kg) for all methods during the day in FY95.

METHOD	Persons	Gears	Trips	Per-Hrs	Gear-Hrs	Catch	Finfish	Inverts	CPUE†
Hook & Line	24,550	26,193	16,376	79,259	84,467	11,796	11,796	0	0.21 wd
Cast Net	6,687	5,862	5,207	18,448	16,220	5,351	5,351	0	0.40 wd
Gill Net	5,317	2,613	2,054	24,302	11,983	6,134	5,624	510	0.82 wd
Surround Net	896	347	347	2,901	1,102	346	346	0	0.52 wed
Spear Snorkel	826	796	446	3,033	2,928	1,779	1,506	273	0.72 wed
Spear Scuba	0	0	0	0	0	0	0	0	0.0
Drag Net	36	9	9	60	15	23	23	0	1.54 wed
Hooks & Gaffs	760	1,055	500	1,802	2,512	699	0	699	1.13 wd
Other††	252	252	235	109	109	468	0	468	4.77 wed
TOTAL	39,323	37,126	25,173	129,914	119,328	26,595	25,254	1,778	0.22

†CPUE summary derives the greatest weekday (wd) and weekend day (wed) values. The greatest CPUE value for hook and line was in region 3.

††Other Methods usually include: gleaning, hand nets, traps, and spears.

The rank order for day fishing participation placed hook and line first with 24,550 or 62% participants. Cast netting and gill netting placed second and third respectively with 6,687or 17% and 5,317 or 14% of the participants (Table 2).

Hook and line fishing remained the most practiced night fishing method with 12,513 participants or 67% of night participation. The second most practiced method was spearfishing with snorkel gear with 2,773 participants or 15%, while gill netting followed in third with 2,595 participants or 14% of night participation (Table 3).

Table 3. Combined estimated inshore participation, effort, and total harvest (kg) for all methods during the night in FY95.

METHOD	Persons	Gears	Trips	Per-Hrs	Gear-Hrs	Catch	Finfish	Inverts	CPUE†
Hook & Line	12,513	12,687	5,611	40,346	40,916	2,299	2,225	74	0.07 wn/wen
Cast Net	207	149	108	370	271	60	60	0	0.93 wen
Gill Net	2,595	1,081	728	7,852	3,272	2,145	2,027	118	0.68 wn
Surround Net	0	0	0	0	0	0	0	0	0.0
Spear Snorkel	2,773	2,773	1,069	6,377	6,377	7,470	6,947	523	1.46 wn
Spear Scuba	290	284	114	284	276	711	702	9	5.02 wn
Drag Net	89	21	21	135	31	52	52	0	3.47 wn
Hooks & Gaffs	0	0	0	0	0	0	0	0	0.0
Other††	332	332	242	777	777	196	24	172	0.25 wn
TOTAL	18,799	17,327	7,892	56,142	51,920	12,933	12,037	896	0.25

†CPUE summary derives the greatest weeknight (wn) and weekend night (wen) values. The greatest CPUE value for hook and line was in region 3.

††Other Methods usually include: gleaning, hand nets, traps, and spears.

CATCH PER UNIT EFFORT (CPUE)

Other methods of fishing, e.g., gleaning, trapping, and dip netting, had the highest daytime CPUE of 4.77 kg/gh for weekend day fishing (Tables 1 and 2) and drag netting followed in second with 1.54 kg/gh (note: the drag net CPUE was estimated from one daytime catch of primarily ti'ao and i'e'). Hooks and gaffs were third with 1.13 kg/gh. Spearfishing with scuba gear had the highest nighttime CPUE of 5.02 kg/gh for night fishing and drag netting followed in second with 3.47 kg/gh (Tables 1 and 3). Spearfishing with snorkel gear was third with 1.46 kg/gh.

The information concerning effort and harvest for methods not discussed are included in the summary Tables 1-3.

Other nearshore fisheries harvests on Guam, including spearfishing with snorkel and scuba gear by berthed and trailered boats, were recorded in the FY95 Offshore Fisheries Report (Study F-1, Job 1).

SPECIES COMPOSITION

The expanded species composition for the combined, day, and night efforts were calculated for FY95. The top non-seasonal reef fish species caught was the bluespine unicornfish, *Naso unicornis,* with 5.7 mt or 15.53% of the finfish total and *Caranx* i'e' was the top seasonal and second overall species caught with 2.9 mt or 7.92% of the finfish total. Acanthuridae was the top family of finfish harvested with 9.8 mt or 26.66% of the combined harvest in FY95 (Table 4).

Table 4. FY95 combined day and night catch composition for the top ten species and families of finfish harvested. Juvenile *Caranx ignobilis, C. melampygous, C. papuensis,* and *C. sexfasciatus* (i'e' ≤ 200mm), *Mulloides flavolineatus* (ti'ao ≤ 100mm), and *Siganus spinus* (mañåhak), are listed separately from the intermediate to adult size classes. Finfish harvest percentages were derived from the total day and night catch (36,683 kg).

SPECIES	Harvest		FAMILY	Harvest	
	kg	%		kg	%
Naso unicornis	5,695.64	15.53	Acanthuridae	9,779.90	26.66
Caranx i'e'	2,904.58	7.92	Carangidae	5,430.45	14.80
Siganus spinus	2,517.20	6.86	Mullidae	3,881.09	10.58
Acanthurus triostegus	2,101.56	5.73	Siganidae	3,041.92	8.29
Mulloides flavolineatus	1,816.84	4.95	Mugilidae	1,801.92	4.91
Mulloides ti'ao	1,290.09	3.52	Lethrinidae	1,759.13	4.80
Caranx sexfasciatus	1,022.68	2.79	Scaridae	1,748.73	4.77
Epinephelus merra	948.15	2.58	Labridae	1,459.79	3.98
Cheilinus trilobatus	811.89	2.21	Lutjanidae	1,230.56	3.35
Selar crumenophthalmus	750.37	2.05	Serranidae	1,088.59	2.97
TOTAL ANNUAL COMBINED CATCH	19,859.00	54.14		29,991.52	81.76

The top day and nighttime species caught was the bluespine unicornfish, *Naso unicornis*, with 3.6 mt or 14% of the day total (91% by hook and line, 6% by gill net, and 3% by spear snorkel, Table 5) and 2.1 mt or 17% of the night total (91% by spear snorkel 7% by spear scuba, and 2% by hook and line, Table 6). For family harvests, Carangidae ranked

first for day, with 10.4 mt or 22.16% and Acanthuridae ranked first at night (top 3 species), with 14.3 mt or 22.88% in FY95.

Table 5. FY95 combined day catch composition for the top ten species and families of finfish harvested. Juvenile *Caranx ignobilis, C. melampygous, C. papuensis*, and *C. sexfasciatus* (i'e' ≤ 200mm), *Mulloides flavolineatus* (ti'ao ≤ 100mm), and *Siganus spinus* (mañåhak), are listed separately from the intermediate to adult size classes. Finfish harvest percentages were derived from the total day catch (25,254 kg).

SPECIES	Harvest		FAMILY	Harvest	
	kg	%		kg	%
Naso unicornis	3,618.11	14.33	Acanthuridae	5,904.36	23.38
Caranx i'e'	2,336.88	9.25	Carangidae	4,142.87	16.40
Siganus spinus	2,047.88	8.11	Mullidae	3,162.80	12.52
Acanthurus triostegus	1,753.21	6.94	Siganidae	2,361.85	9.35
Mulloides flavolineatus	1,417.57	5.61	Mugilidae	1,423.11	5.64
Mulloides ti'ao	1,256.54	4.98	Labridae	1,224.66	4.85
Caranx sexfasciatus	878.41	3.48	Lethrinidae	1,171.08	4.64
Epinephelus merra	667.50	2.64	Lutjanidae	906.52	3.59
Cheilinus trilobatus	645.97	2.56	Scaridae	785.65	3.11
Liza vaigiensis	635.95	2.52	Gerreidae	725.65	2.87
TOTAL ANNUAL DAY CATCH	15,258.02	60.42		21,808.55	86.36

Table 6. FY95 combined night catch composition for the top ten species and families of finfish harvested. Juvenile *Caranx ignobilis, C. melampygous, C. papuensis*, and *C. sexfasciatus* (i'e' ≤ 200mm), *Mulloides flavolineatus* (ti'ao ≤ 100mm), and *Siganus spinus* (mañåhak), are listed separately from the intermediate to adult size classes. *Myripristis* spp. are listed at the genus level due to identification problems. Finfish harvest percentages were derived from the total night catch (12,037 kg).

SPECIES	Harvest		FAMILY	Harvest	
	kg	%		kg	%
Naso unicornis	2,077.53	17.26	Acanthuridae	3,875.54	32.20
Acanthurus lineatus	719.34	5.98	Carangidae	1,287.58	10.70
Caranx i'e'	567.70	4.72	Scaridae	963.08	8.00
Myripristis spp.	492.61	4.09	Holocentridae	953.99	7.93
Siganus spinus	469.32	3.90	Mullidae	718.29	5.97
Mulloides flavolineatus	399.27	3.32	Siganidae	680.07	5.65
Selar crumenophthalmus	397.16	3.30	Lethrinidae	588.05	4.89
Acanthurus triostegus	348.35	2.89	Serranidae	397.88	3.31
Naso lituratus	348.25	2.89	Mugilidae	378.81	3.15
Epinephelus merra	280.65	2.33	Lutjanidae	324.04	2.69
TOTAL ANNUAL NIGHT CATCH	6,100.18	50.68		10,167.33	84.47

Spearfishing with scuba gear did not account for a significant amount of fish caught during the survey period, despite the high catch rate (personal observation) using this method. One reason for this occurrence is that a small percentage of scuba spearfishermen shore-dive at any one time making it difficult to encounter them during an inshore catch

survey. The greatest number of spear scuba interviews were obtained during the offshore surveys (Study F-1, Job 1) in FY95.

Method Harvests

The top harvest of finfish species for hook and line method was calculated for FY95 (Table 7). *Naso unicornis* ranked first with 3.3 mt (27.92%) for day and *Epinephelus merra* ranked third as the top non-seasonal species of finfish caught at night with 0.1 mt (6.62%). Seasonal species ranked high for day and night harvests for FY95. *Caranx* i'e' ranked first for day with 1.6 mt (13.16%) and second at night with and 0.5 mt (22.19%), while *Selar crumenophthalmus* ranked first at night with 0.4 mt (17.85%).

Table 7. FY95 day and night catch composition for the top ten species of finfish harvested by hook and line method. Juvenile *Caranx ignobilis, C. melampygous, C. papuensis*, and *C. sexfasciatus* (i'e' ≤ 200mm), and *Siganus spinus* (mañåhak), are listed separately from the intermediate to adult size classes. Finfish harvest percentages were derived from the total day (11,796 kg) and night (2,225 kg) hook and line catch.

Day Species	Harvest		Night Species	Harvest	
	kg	%		kg	%
Naso unicornis	3,293.18	27.92	*Selar crumenophthalmus*	397.16	17.85
Caranx i'e'	1,552.54	13.16	*Caranx* i'e'	493.75	22.19
Caranx sexfasciatus	878.41	7.45	*Epinephelus merra*	147.20	6.62
Siganus spinus	742.55	6.29	*Caranx sexfasciatus*	121.22	5.45
Cheilinus trilobatus	563.72	4.78	*Lethrinus harak*	105.91	4.76
Epinephelus merra	560.96	4.76	*Lethrinus obsoletus*	91.53	4.11
Lethrinus harak	420.57	3.57	*Myripristis berndti*	61.65	2.77
Liza vaigiensis	415.44	3.52	*Lutjanus fulvus*	58.13	2.61
Cheilio inermis	350.97	2.98	*Epinephelus hexagonatus*	56.13	2.52
Lutjanus monostigmus	318.93	2.70	*Naso unicornis*	43.61	1.96
Total Top Ten Hook & Line Catch	9,097.27	77.12		1,576.29	70.84
Total Combined Hook & Line Catch	10,673.56	76.13			

The top harvest of finfish species for gill net method was calculated for FY95 (Table 8). *Acanthurus triostegus* ranked first for day, with 0.8 mt (14.21%) and second at night, with 0.1 mt (6.67%), while *Mulloides flavolineatus* ranked first at night, with 0.2 mt (11.10%) of the total gill net harvest.

The top harvest of finfish species for snorkel spearfish method was calculated for FY95 (Table 9). *Lethrinus xanthochilus* ranked first for day, with 0.2 mt (13.56%), while *Naso unicornis* ranked first at night, with 1.7 mt (23.75%) and third for day, with 0.1 mt (8.35%).

Seasonal Harvests

The seasonal catch of certain juvenile fishes is widely anticipated by local fishermen. The FY95 catches of ti'ao and i'e' were well represented within the expansion estimates (Tables 4-6), especially *Caranx* i'e'. During FY95, pulses of recruiting ti'ao and i'e' occurred from June-September 1995. Ti'ao (*Mulloides* spp. ≤ 100mm) and i'e' (*Caranx*

spp.≤ 200mm) ranked second and sixth respectively for day harvest (Table 5) and i'e' ranked third for night harvest (Table 6) in FY95.

Table 8. FY95 day and night catch composition for the top ten species of finfish harvested by gill net method. Juvenile *Caranx ignobilis, C. melampygous, C. papuensis*, and *C. sexfasciatus* (i'e' ≤ 200mm), *Mulloides flavolineatus* (ti'ao ≤ 100mm), and *Siganus spinus* (mañåhak), are listed separately from the intermediate to adult size classes. *Gerres* spp. was listed at the genus level due to identification problems. Finfish harvest percentages were derived from the total day (5,624 kg) and night (2,027 kg) gill net catch.

Day Species	Harvest		Night Species	Harvest	
	kg	%		kg	%
Acanthurus triostegus	799.44	14.21	*Mulloides flavolineatus*	225.02	11.10
Gerres spp.	657.18	11.69	*Acanthurus triostegus*	135.22	6.67
Mulloides flavolineatus	614.89	10.93	*Gerres* spp.	129.96	6.41
Crenimugil crenilabis	496.63	8.83	*Crenimugil crenilabis*	124.40	6.14
Siganus spinus	401.57	7.14	*Siganus randalli*	92.83	4.58
Mulloides vanicolensis	360.94	6.42	*Caranx ignobilis*	84.73	4.18
Mulloides ti'ao	292.42	5.20	*Scolopsis lineatus*	80.42	3.97
Naso unicornis	284.69	5.06	*Siganus spinus*	65.51	3.23
Liza vaigiensis	181.59	3.23	*Kulia rupestris*	51.49	2.54
Caranx i'e'	172.97	3.08	*Neoniphon sammara*	44.36	2.19
Total Top Ten Gill Net Catch	4,262.32	75.79		1,033.94	51.01
Total Combined Gill Net Catch	5,296.26	62.08			

Table 9. FY95 day and night catch composition for the top ten species of finfish harvested by snorkel spear method. Finfish harvest percentages were derived from the total day (1,506 kg) and night (6,947 kg) snorkel spearfish catch.

Day Species	Harvest		Night Species	Harvest	
	kg	%		kg	%
Lethrinus xanthochilus	204.25	13.56	*Naso unicornis*	1,650.09	23.75
Epinephelus merra	126.48	8.40	*Acanthurus lineatus*	538.35	7.75
Naso unicornis	125.69	8.35	*Siganus spinus*	448.21	6.45
Diodon hystrix	94.27	6.26	*Myripristis*spp.	403.22	5.80
Acanthurus xanthopterus	86.41	5.74	*Naso lituratus*	203.14	2.92
Carangoides orthogrammus	62.85	4.17	*Acanthurus triostegus*	201.02	2.89
Scarus sordidus	50.75	3.37	*Leptoscarus vaigiensis*	198.70	2.86
Naso lituratus	40.85	2.71	*Parupeneus barberinus*	172.90	2.49
Balistoides undulatus	33.78	2.24	*Kyphosus vaigiensis*	170.68	2.46
Lethrinus harak	32.60	2.16	*Cheilinus trilobatus*	149.20	2.15
Total Top Ten Spear Snorkel Catch	857.93	56.97		4,135.51	59.53
Total Combined Spear Snorkel Catch	4,993.44	59.07			

FY95 marked a poor recruitment year for mañåhak (ha'tang or *Siganus spinus* and lesso' or *S. argenteus*). There were no reported runs large enough to conduct surveys. However, there were reports of small amounts of fish being caught at Nimitz Beach in Agat and other locations around the island.

The atulai (*Selar crumenophthalmus*) season was marginally successful with 0.8 mt or 2% of the total catch for FY95. Approximately 84% of the total atulai catch were caught with hook and line, due to the high incidence of catch interviews at the Agana Boat Basin channel (Fig. 1, location 9 and Table 9).

Invertebrates Harvested

In addition to finfish, a significant number of marine invertebrates were harvested from Guam's reefs (Tables 1-3). An estimated 1.0 mt of octopus (36% of the total invertebrate harvest) were caught island-wide in FY95. Daytime octopus harvests accounted for 0.7 mt (97% by hooks and gaffs and 3% by gill net), while nighttime harvests accounted for 0.3 mt (88% by spear snorkel, 11% by gill net, and 1% by spear scuba) in FY95.

The second most caught invertebrate was the spiney lobster, *Panulirus penicillatus*, with an estimated 0.4 mt (12% of the total invertebrate harvest) island-wide catch in FY95. Daytime crab harvests accounted for 0.02 mt (84% by spear snorkel and 16% by gill net), while nighttime harvests accounted for 0.1 mt (92% by spear snorkel and 8% by spear scuba) in FY95. The third most caught invertebrate was the crenate swimming crab, *Thalamita creanata*, with an estimated 0.2 mt in FY95.

Spearfishing with scuba and snorkel gear accounts for a significant amount of spiny lobster, slipper lobster, and miscellaneous decapods, e.g., *Carpilius maculatus*, harvested at night (based on personal observations by R.F. Myers, Study F-1, Job 1), but these species were not significantly represented in the inshore survey estimates due to the rarity of snorkel and scuba spearfishing interviews.

Other methods, e.g., gleaning, trapping, and dip netting, produced an estimated 0.66 mt of finfish and invertebrates, e.g., Mugilidae and Squillidae, with a catch rate of 0.75 kg/ph of fishing effort.

RECOMMENDATION

The establishment of the 4D program has greatly reduced the time needed to compile and analyze Guam's inshore survey data. Because of this, more effort has been spent to continually upgrade our data collection procedures to ensure statistical reliability.

Initial aerial observations show that 87.2% of the participants and 87.3% of the gear-units are being surveyed on the shore participation route when compared with the island-wide count. Even though this falls within the estimated 85% from previous aerial surveys (FY63-79), it is recommended that the aerial surveys be continued. The sampling technique has improved since the initiation of the aerial surveys and an improved quantitative analysis has been done for island-wide inshore fishing effort.

Considering the inshore fisheries survey provides information important for management and planning, it is recommended that the job be continued. Due to the inadequacies of the "inshore-catch" survey window (especially at night for certain methods), harvests were not representative of the actual participation and includes the following methods for day: surround net, spear snorkel, drag net, hooks and gaffs, and other methods; and night: cast net, surround net, spear scuba, drag net, and hooks and gaffs. Methods encountered

more frequently, i.e., hook and line, cast net (day only), gill net, spear snorkel and other methods (night only), had confidence limits less than 27.4% in FY95.

Future concerns lie with enforcement of the Recreational Water-Use Master Plan (RWUMP) of the jetski operations in East Agana Bay by the Department of Parks and Recreation (DPR) during the mañåhak runs and implementation of this plan in Cocos Lagoon. This will allow the maximum allowable time for fishermen to harvest the resource without interference from jetski activity.

The increased availability and affordability of certain fishing gear methods has also changed on Guam. Hook and line has shown a significant increase since the early 1980's and has grown in popularity, especially with the i'e' fishery. Gill net use has remained stable over the last decade, but the poor quality and disposability of the cheaper nets has created a situation of "ghostnetting" on our reefs. Spearfishing with scuba gear has also increased (especially offshore surveys), despite the fact that it was rarely encountered during the "inshore-catch" surveys in FY95.

Overall declines in annual harvests and shifts in species composition have occurred in the last ten fiscal years. Strict measures should be taken to manage the species of fish that are steadily decreasing in the overall harvest estimates, i.e., implementation of marine preserves and/or tougher regulations, in order to prevent the over exploitation of our fishery resource.

PROJECT COST

The estimated cost for this project is $81,000.

Report prepared by: Todd J. Pitlik

APPENDIX 1

INSHORE AERIAL SURVEY

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

A total of 23 "inshore aerial" surveys were conducted in FY95 for a total of 1,054 persons and 951 gear units. Hook and line was the most frequently encountered method with 624 persons and 621 gear units. A ratio of participants observed in areas outside the inshore participation route to the total number for all methods surveyed during the "inshore aerial" were calculated as variables (P_2 values) for the inshore expansion. The values ranged from 64% for weekday gill net to 100% for rare and for the following night-practiced methods: surround net, spear scuba, hooks and gaffs, and drag net fishing.

Incidental biological sightings resulted in a total of 240 turtles, 544 dolphins, 39 sharks, 22 eagle rays, 5 manta rays, and 2 sting rays for FY95.

BACKGROUND

Inshore fishing surveys have been conducted by the Department of Aquatics and Wildlife Resources (DAWR) since the early 1960's to monitor and collect a long-term database on the total fishing effort and catch from Guam's reefs. The "inshore-catch" and "inshore-participation" surveys were developed to collect catch and effort data in near-shore areas easily accessible by motor vehicle. In addition, the "inshore-aerial" survey was established in the early 60's and reinstated in FY90 to survey effort in areas that could not be easily accessed by a vehicle.

PROCEDURES

"Inshore-aerial" surveys were conducted twice monthly on regularly scheduled participation days (one weekday / weekend). Start times are moved up in one-hour intervals for each subsequent survey (0800-1200h), then repeated after reaching 1200h. Visual observations of areas not covered in the "inshore-participation" survey (Fig. 1: locations: 22, 27, 28, 35-39, 44-50, 58, 59, 70, and 73-92) included fishing effort data. The first scheduled weekday and weekend participation survey dates of each month were selected to allow rescheduling in the event of poor weather conditions.

Each survey started in location 11 and proceeded in a clockwise direction all the way around the island to location 12 (Fig. 1). The seaward flight distance from the reef margin was 200-300m with an altitude of 150-200m. The aerial itinerary also included a circular flight pattern within Cocos Lagoon and Apra Harbor. In addition, the pilot was instructed to circle over reef flat areas when it was difficult to observe or determine activity.

The aerial survey observations were sorted by method. An observed ratio of the areas outside the inshore participation route were compared to the total number of observations for the island. The resultant P_2 value provides a variable (%) that can be used to expand inshore participation values to island-wide participation values.

Other incidental data collected, included observations of marine mammals, turtles, sharks, and rays at or near the surface of various reef zones, e.g., Cocos Lagoon and the fore reef slope, along the aerial survey route.

The FY95 inshore harvest estimates were statistically expanded by a computer software package for Macintosh known as the 4th Dimension database program (4D). The 4D program utilizes formulae described in the FY83 report (Project FW-2R-20, Sub-Project F, Study F-1, Job 2) to compile and expand inshore survey data for the fiscal year.

RESULTS

The most frequently encountered methods included hook and line, cast net, gill net, snorkel spear, and other methods, while surround net, scuba spear, hooks and gaffs, and drag net methods were less common. Ratio frequencies were highest (100%) for the least common methods, which was due to the rarity of its use during the day included: surround net, scuba spear, hook and gaff, and drag net. Hook and line, cast net, gill net, snorkel spear, and other methods (weekday and weekend days respectively) had P_2 values (Table 1) listed as percentages: (86 / 82), (69 / 74), (64 / 79), (69 / 88), and (100 / 85), for FY95.

Table 1. P2 values derived from aerial survey data in FY95. Ratios were calculated from a ration of method sightings within aerial locations to participation locations. Method abbreviations are listed as follows: Hook and Line (HL; Cast Net (CN); Gill Net (GN); Surround Net (SN); Spear Snorkel (SpSn); Spear SCUBA (SpSc); Hooks and Gaffs (HG); Drag Net (DN); and Other Methods (OM).

Ratios	HL	CN	GN	SN	SpSn	SpSc	HG	DN	OM
Weekday	23/137	14/31	14/25	0/0	10/22	0/0	0/0	0/0	2/0
Weekend	83/381	24/69	19/71	0/34	7/52	0/0	0/23	0/0	2/11
WD Ratio	23/160	14/45	14/39	0/0	10/32	0/0	0/0	0/0	2/2
WE Ratio	83/464	24/93	19/90	0/34	7/59	0/0	0/23	0/0	2/13
WD P2	86	69	64	100	69	100	100	100	100
WE P2	82	74	79	100	88	100	100	100	85

The greatest number of people fishing in participation areas during the aerial survey used hook and line on weekdays and weekends for a total of 137 / 136 and 381 / 380 persons / gear units respectively for FY95 (Table 2). Hook and line was also the most frequently used method in aerial areas for a total of 23 / 23 persons and 83 / 82 gear units for weekdays and weekends respectively for FY95.

Dolphins topped the list of the most frequently sighted marine animals during the aerial surveys with the greatest monthly total of 147 sightings in January and an annual total of 544 sightings in FY95 (Table 3). Turtles and sharks ranked second and third respectively with an annual total of 240 and 39 sightings. The greatest monthly total of turtles were sighted in January with 45 and sharks in May with 11. Eagle rays were sighted more frequently than sting rays and manta rays combined (7) with 22 sightings. The greatest monthly total of eagle rays were sighted in March with 15, possibly due to spawning or feeding aggregations within Cocos Lagoon.

Table 2. Total number of people and gear units observed during aerial surveys in FY95. Method abbreviations are listed in Table 1 with weekday (WD) and weekend (WE) listed below.

	Within Par Route				Outside Par Route			
	Persons		Gears		Persons		Gears	
Methods	WD	WE	WD	WE	WD	WE	WD	WE
HL	137	381	136	380	23	83	23	82
CN	31	69	30	65	14	24	13	23
GN	25	71	10	38	14	19	7	10
SN	0	34	0	5	0	0	0	0
SpSn	22	52	22	52	10	7	10	7
SpSc	0	0	0	0	0	0	0	0
HG	0	23	0	23	0	0	0	0
OM	0	11	0	11	2	2	2	2

Table 3. Number of turtle, dolphin, shark, ray sightings in FY95.

	MONTHS												
SPECIES	O	N	D	J	F	M	A	M	J	J	A	S	TOTAL
Turtle	21	23	15	45	15	19	18	36	8	6	15	19	240
Dolphin	0	59	12	64	33	61	147	18	50	0	50	50	544
Shark	2	1	0	9	5	8	3	11	0	0	0	0	39
Sting Ray	0	0	0	0	3	15	0	4	0	0	0	0	22
Eagle Ray	0	0	0	0	0	1	1	0	0	0	0	0	2
Manta Ray	0	0	0	0	1	2	1	0	0	0	0	1	5

FLIGHT COST

The cost of the project was $9,500.

Report prepared by: Todd J. Pitlik

APPENDIX 2

KID'S FISHING DERBIES

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

Two marine fishing derbies "for kids only" were held in cooperation with the 36th Air Base Wing at Sirena Beach on Andersen Air Force Base (AAFB) on October 22-23, 1994 and June 17-18, 1995. The derbies were open to 100 and 150 participants respectively, for the two-day events, with a total of 64 and 61 children participating respectively. Previous kids fishing derbies sponsored by the Department of Agriculture's Division of Aquatic and Wildlife Resources (DAWR) were held at Hotel Wharf on December 1-2, 1990, and three freshwater derbies were held at Fena Lake in cooperation with the Naval Magazine Command on March 4-5, 1991, March 21-22, 1992, and January 15-16, 1994. DAWR also contributed technical assistance to the 1st Annual Governor's Cup Shoreline Fishing Tournament for Kids sponsored by the Department of Parks and Recreation and held on July 29, 1995.

OBJECTIVES

The major objectives of these derbies are to encourage fishing as a form of recreation for children, to use these events as opportunities to instill environmental ethics and conservation practices, and to increase environmental awareness in the participants. The derbies have a size and bag limit to give participants a chance to practice conservation and also give participants the option to release any fish caught. These derbies are open to children 7 to 12 years of age, and are preceded by a fishing clinic a week prior to the event. The fishing clinic provides parents and participants an opportunity to learn the basic knowledge and skills to go fishing. This includes practicing basic skills such as knot-tying and casting.

PROCEDURES

The major aspects involved in the planning of a kids fishing derby include the selection of a fishing site, advertising, using flyers distributed to the schools, placing ads in the local paper, radio and television appearances, the registration process which is done, solicitation of prizes by virtue of Executive Order 91-08 of the Territory of Guam, conducting a fishing clinic a week prior to the event, providing refreshments and a staging area for a safety briefing prior to the event, an awards ceremony after the fishing events, ensuring the presence of medical personnel, coordinating media coverage before and during the event, providing each participant, the derby winners, and contributors with certificates, organizing staff to serve as officials during the event, and preparation of a post-derby report which includes recommendations from the participants. The minimum time needed to coordinate a kids fishing derby is approximately one month.

Fishing derbies held in cooperation with military installations, involved individuals from both agencies who designated as points of contact to ensure that requirements for both agencies are met and that the delineation of duties and responsibilities both well-defined and equitable. A Cooperative Agreement between the Government of Guam and the 36th Air

Base Wing at AAFB was entered into to help facilitate organizing kids fishing derbies on AAFB and was given final approval on July 11, 1995.

Safety, a major consideration for these kids fishing derbies, involves the selection of a fishing site with a safe shoreline, not allowing participants to enter the water at any time, requiring that each participant has an adult guardian present with them at all times, having a medical corpsman present during the fishing hours, and requiring all participants to attend a Safety Briefing held before each fishing day. During the event, sunscreen, refreshments including cold water, and a sheltered rest area are provided. During the fishing clinic, safety guidelines are reviewed and dressing appropriately for fishing is demonstrated.

RESULTS

The first derby, held in FY95 at Sirena Beach, was originally scheduled for September 17-18, 1994 but was postponed for a month due to bad weather, which was accompanied by lightning. The derby was rescheduled for the earliest weekend that had a peak high tide during the derby fishing hours, which was October 22-23, 1995. A total of 64 children participated, 25 on Saturday and 39 on Sunday, catching a total of 27 fish, 17 on Saturday and 10 on Sunday. The AAFB Commander and Vice Commander of the 36th Air Base Wing attended the event on separate days and assisted with the awards presentation.

A second derby was held at Sirena Beach with the number of participants increased to 150. A total of 61 children participated, 39 on Saturday and 22 on Sunday, catching a total of 21 fish, 10 on Saturday and 11 on Sunday. The Director of Agriculture, AAFB Commander of the 36th Air Base Wing, and AAFB Commander of Support Services, attended the event and assisted with the awards presentation.

Technical assistance was provided to the Department of Parks and Recreation for the 1st Annual Governor's Cup Shoreline Fishing Tournament held on July 29, 1995. Target species for the tournament was i'e, juvenile trevally (genus *Caranx*) which are caught during seasonal runs. Technical assistance was given prior to the derby, and three DAWR staff members served as technical advisers and shoreline judges.

RECOMMENDATIONS

To increase the number of participants, advertising will incorporate the use of mini-flyers to be distributed to school children, and highway banners. These banners will be designed so that they can be used for all kids derbies sponsored by DAWR and will give continuous exposure for the kid's derbies.

An overwhelming response from participants and guardians was that kids derbies should be held more often. At least two derbies should be held during the next fiscal year, a marine derby and possibly a freshwater derby, to give participants an opportunity to do both types of fishing. Other areas can be explored as possible shoreline kids derby sites such as public beaches or beaches on other military installations.

Report Prepared by: Thomas Flores, Jr.

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: F-1R-3
SUB-PROJECT NO.: F-1
STUDY NO.: 2
JOB NO.: 1

STUDY 2: Computerized Data Manipulation of Guam's Fisheries Data

JOB TITLE: Fisheries Data Processing (2430)

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

During FY95, it was determined that it was unnecessary to fill the vacant programmer position to reactivate this project. Presently, the current project leaders are performing the jobs this project supported.

BACKGROUND

Guam's Division of Aquatic and Wildlife Resources (DAWR) has been collecting fisheries information over the past 24 years (with only the last 15 years of data being reliable). As a result, an enormous amount of fisheries management data has been accumulated. Computers have been used over the past eight years by DAWR to store and analyze this data. DAWR personnel, working closely with the National Marine Fisheries Service (NMFS), have developed and purchased programs for analyzing the DAWR offshore and inshore fisheries survey data.

In FY83, a program entitled the Guam Offshore Expansion System (GOES) was developed and based on the current practices of offshore data analysis. In FY85, a Guam Inshore Expansion System (GIES) was completed and tested for errors, which underwent modifications in FY90 to take advantage of the storage capability and speed of computers that are currently available. Since then, all data collected for the offshore and inshore fisheries surveys have been analyzed through the use of these two programs.

Job 3, Fisheries Data Processing, has been jointly funded by the U.S. Fish and Wildlife Service (USFWS), NMFS, and the Western Pacific Regional Fisheries Management Council (WESPAC). These federally-supported programs remain active but do not require individual programmer positions to operate. The project leader performs the required analysis and key-punching. Efforts to update the offshore expansion process are still under-way.

OBJECTIVES

1. Computerize the DAWR's offshore and inshore marine fisheries data and transfer the finalized fisheries data files and reports to NMFS personnel in Honolulu, Hawaii for regional application.

2. Provide technical assistance to DAWR staff biologists in the form of efficient statistical analysis and report generation.

PROCEDURES

Guam's offshore fisheries survey data are analyzed by a system of computer programs known as the GOES. This programming package is a 5-step system that summarizes, sorts, and statistically expands the survey data to produce monthly and annual catch, effort, and species composition estimates. Two proportionality constants and a "total participation boat count" are calculated and manually entered into the expansion module by the user. Reports are generated by the GOES that give a breakdown of the estimated offshore harvest by gear type on a monthly and annual basis. Also, an estimated harvest by species is generated for each gear type with a corresponding percentage of the total catch for that gear type.

Although data collections continue, this project has remained inactive in FY95. The need for this program has diminished since the project leaders are now handling their own analysis and key punching needs.

RECOMMENDATION

The project should be phased out and the analytical needs of each project should coordinated by the project leader.

PROJECT COST

There were zero costs incurred by this project during FY95.

Report prepared by: Gerald W. Davis

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO: F-IR-3
SUB-PROJECT NO: F-1
STUDY NO.: 3
JOB NO.: 1

STUDY 3: Studies of Guam's Recreationally Important Fish (2450)

JOB TITLE: Biology of *Lethrinus harak* and *L. obsoletus*

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

In keeping with the FY94 recommendation to complete the project by the end of FY95, field work for the study of the emperor snappers, *Lethrinus harak* and *Lethrinus obsoletus*, was terminated in June to allow for compilation of all data collected for the project since FY85. However, in the process of assembling the data, it was discovered that the fecundity estimates thought to have been completed by the previous investigator prior to the tabling of the project in FY85, only consisted of egg counts for one specimen of *L. harak* and two of *L. obsoletus*. In order to establish a reliable estimate of fecundity for the two species, egg counts should have been made of at least one ripe specimen from each 10mm size class beginning at the 170mm size class where the collection method became effective for each species. Because this data is essential for the completion of the study, supplemental field and lab work to gather this information will extend into FY96. Consequently, the completion of this study and the production of a final report has been deferred until the end of FY96.

Based on the findings at the completion of the study, recommendations may be made for the management and preservation of stocks of *L. harak* and *L. obsoletus* in Guam's waters.

BACKGROUND

The family Lethrinidae (emperors) are close relatives of snappers but differ primarily by having a maxillary completely hidden by a bare or near-bare preopercle and conical or molariform teeth on the sides of the jaws. Lethrinids also have fairly thick lips, canine teeth towards the front of the jaws, a continuous dorsal fin with X spines and 9 to 10 rays, and an anal fin with III spines and 8 to 10 rays (Myers, 1991).

Lethrinus harak, commonly known as the blackspot or thumbprint emperor, inhabits mangroves, coral rubble, shallow sandy lagoons, channels, and seagrass areas adjacent to coral reefs. It feeds on crustaceans, molluscs, polychaetes, echinoderms and small fishes, and grows to maximum total length of about 50cm, but more commonly to between 20 to 30cm. *L. harak* have been reported to spawn in large aggregations year-round during the first five days of the lunar month in the lagoons of Belau (Carpenter & Allen, 1989).

Lethrinus obsoletus, commonly known as the orange-striped emperor, is also found in seagrass beds and sand and rubble areas of lagoons and reefs. Much like *L. harak*, *L.*

obsoletus feeds primarily on crustaceans, molluscs and echinoderms, and grows to about 20 to 30 cm with a reported maximum size of 60cm. In Belau, spawning is reported to occur at the outer reef edge during the first five days of the lunar month between November through April (Carpenter & Allen, 1989). *L. harak* has been observed by fishermen to burrow in the sand (Schroeder, 1980) which may serve as a means of escaping their predators and drag nets.

OBJECTIVE

To investigate the need for management of Guam's recreationally important fish through analysis of fishing pressure, population dynamics and life history studies.

METHODS

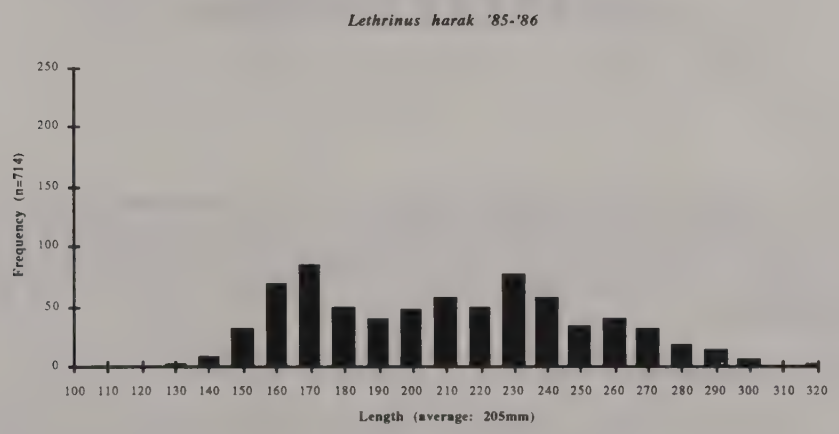
The study of *L. harak* and *L. obsoletus* includes investigations of the following parameters: size distribution, sex ratio, spawning seasonality, lunar occurrence of spawning activity, reproductive contribution among the various size classes, growth rate and historic harvest analysis.

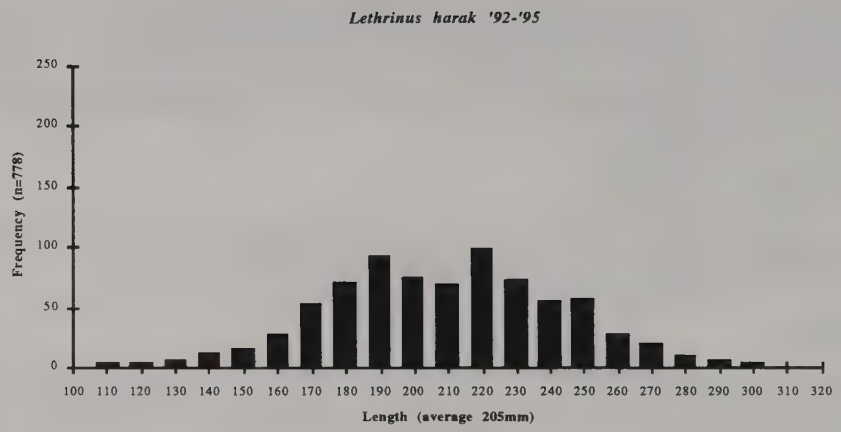
RESULTS

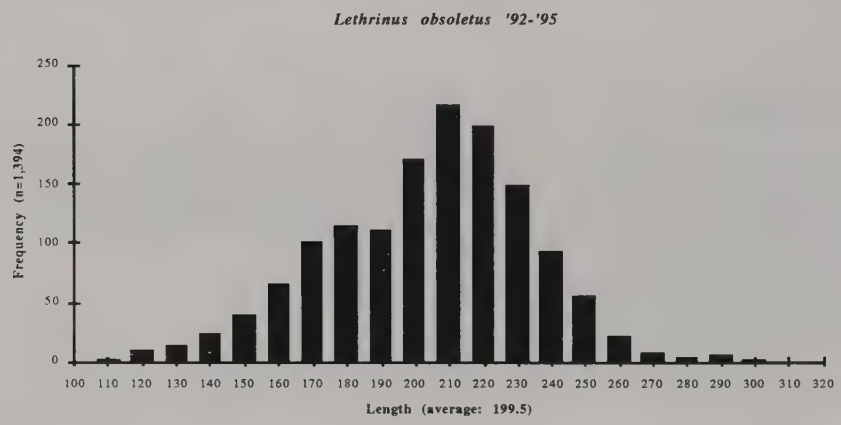
Size Distribution

The length-frequency distributions for both *L. harak* (FY85-FY86 and FY92-FY95, n=1,492) and *L. obsoletus* (FY92-FY95, n=1,394) have been completed and the results are depicted in Figure 1. The average lengths calculated were 205mm for *L. harak* and 199.5mm for *L. obsoletus*.

Figure 1. Length-Frequency Charts







Sex Ratio

Chi-square goodness of fit tests were conducted for both *L. harak* and *L. obsoletus* with the conclusion that both species exhibited a one to one sex ratio, even at the later stages of their life history. The results for each data set is listed in Table 1 and includes separate tests for the larger (upper 25%) size classes to rule out the possibility of sequential hermaphroditism.

Spawning Seasonality

L. harak reportedly spawns year-round while *L. obsoletus* spawns from November through April (Carpenter & Allen, 1989). Laboratory examination of canulated egg samples collected from FY92 through FY95 may be useful in confirming these reports, the results of which will be included in the final project report for FY96.

Lunar Occurrence of Spawning Activity

Carpenter & Allen (1989) also report that both *L. harak* and *L. obsoletus* spawn during the first five days of the lunar month. The difference between the two species however, is that *L. harak* reportedly spawns in lagoons while *L. obsoletus* spawns at the outer reef edge.

Table 1. Chi-Square Tests for 1:1 Sex Ratio

L. harak '85-'86

All Size Classes: 120-320mm			Upper 25%: 240-320mm		
	Female	Male		Female	Male
Actual	475.0	148.0	Actual	136.0	61.0
Expected	311.5	311.5	Expected	98.5	98.5
n=623		n=197			
d.f.=1		d.f.=1			
chi test	3.2504E-39		chi test	9.1154E-08	
.975>probability>.900			.975>probability>.900		

L. harak '92-'95

All Size Classes: 110-300mm			Upper 25%: 230-300mm		
	Female	Male		Female	Male
Actual	85.0	52.0	Actual	50.0	42.0
Expected	68.5	68.5	Expected	46.0	46.0
n=137		n=92			
d.f.=1		d.f.=1			
chi test	0.004811648		chi test	0.404248496	
.975>probability>.900			.900>probability>.500		

L. obsoletus '92-'95

All Size Classes: 110-300mm			Upper 25%: 230-300mm		
	Female	Male		Female	Male
Actual	97.0	157.0	Actual	39.0	23.0
Expected	127.0	127.0	Expected	31.0	31.0
n=254		n=62			
d.f.=1		d.f.=1			
chi test	0.00016673		chi test	0.04215346	
.975>probability>.900			.900>probability>.500		

Fecundity

In the process of reviewing the data collected between FY85 and FY86, it was discovered that the fecundity estimates thought to have been established by the previous investigator only consisted of egg counts for one specimen of *L. harak* and two of *L. obsoletus*. Table 2 lists the extent of the data collected. The number of specimens sampled for both species is insufficient for a reliable fecundity estimate and has resulted in deferring completion of this study until enough specimens have been sampled. In order to establish a more accurate estimate, egg counts will be taken from at least one ripe specimen in as many of the 10mm size classes as possible, beginning at the 170mm size class where the hook and line collection method becomes effective for each species. Because this data is essential for the completion of the study, supplemental field and lab work to gather this information will extend into FY96.

Growth

Between FY92 and FY95, 681 *L. harak* and 1,147 *L. obsoletus* were tagged and released. Only five *L. harak* (0.7%) and 15 *L. obsoletus* (1.3%) were recovered during this time period. The time from tag and release to recovery ranged from 14 to 133 days for *L. harak*

(avg: 77.5 days) and 15 to 111 days (avg: 51 days) for *L. obsoletus*. Given the small number of tag recoveries after such a short period of time (less than 4.5 months), it is not yet clear that the growth data collected from the tagging effort will yield reliable growth rates for these Lethrinids, especially in light of the fact that these fish are reported to reach an age of between 14 to 15 years (Carpenter and Allen, 1989). If available, growth rate estimates for these species may have to be derived from otolith studies of a close relative in the genus Lethrinidae.

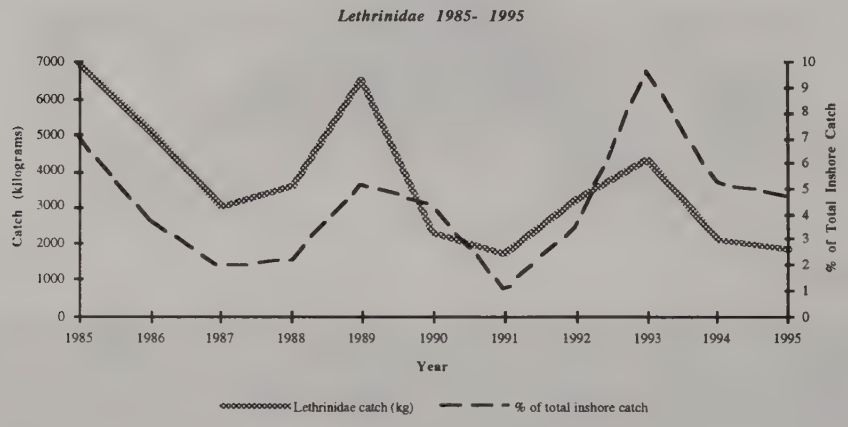
Table 2. Species Egg Counts ('85-86)

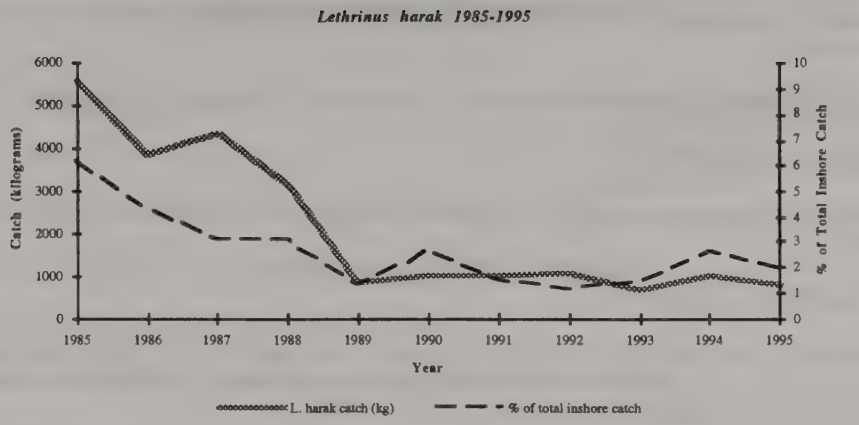
Species	Specimen #	Length (mm)	Weight (g)	Gonad Wt. (g)	Fecundity
Lethrinus harak	479 W	n/a	271.64	4.9390	132,904
Lethrinus obsoletus	330H	231	214.05	1.9870	28,356
	349 H	243	257.32	6.0057	113,729

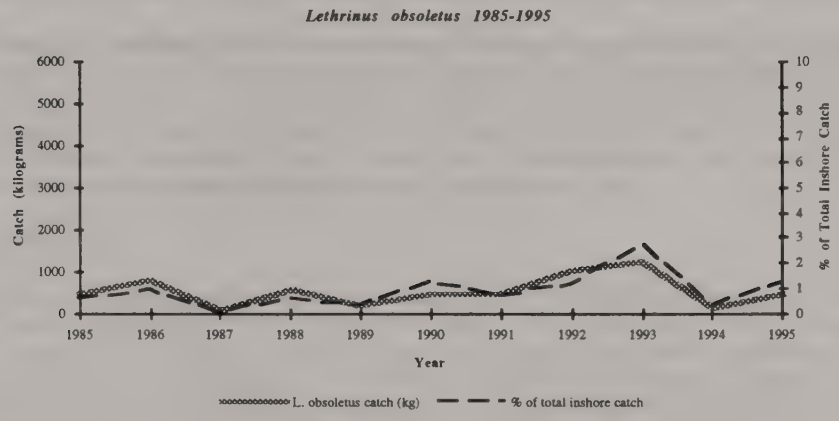
Historic Harvest Analysis

Figure 2 illustrates the FY85-FY95 harvest trends of Lethrinidae on Guam at both the family and species level. The estimates are based on computer-generated expansions of the Guam inshore creel survey data. Also included in the graphs is a percentage composition of each species relative to the total inshore catch for each year.

Figure 2. Lethrinid Catch Trends







RECOMMENDATIONS

This project will provide valuable information essential for the future management of Guam's stocks of *L. harak* and *L. obsoletus* and should be continued with the following recommendations for FY96:

1. Commence field collection of at least one ripe specimen from as many of the 10mm size classes as possible to establish fecundity estimates for *L. harak* and *L. obsoletus*.

2. Conduct field collections just prior to the beginning of the lunar month since both *L. harak* and *L. obsoletus* are reported to spawn within five days after the new moon.

3. If available, investigate the use of otolith studies of close relatives in the genus to aid in the estimation of growth rates of *L. harak* and *L. obsoletus*.

4. Begin laboratory examination of egg-sample collection for average diameter, stage of development and size-frequency distribution relative to lunar cycle and month.

5. Complete the project and final report by the end of FY96.

PROGRAM COSTS

The estimated cost of the Studies of Guam's Recreationally-Important Fish was $60,000.

LITERATURE CITED

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Report prepared by: Andrew A. Torres

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: F-IR-3
SUB-PROJECT NO: F-2
STUDY NO.: 1
JOB NO.: 1

STUDY 1: Development of a Freshwater Monitoring Program

JOB TITLE: Freshwater Monitoring (2440)

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

This job remained inactive until January when a Fisheries Biologist II was hired. Initially, the objective was to develop a scope of work, gather the available literature regarding Guam's freshwater resources and to review possible methods to assess such resources. A general scope of work was completed after reviewing the gathered literature by the end of FY95. The various watersheds were reviewed to develop a sample site priority list and some test survey work was completed to assess feasibility.

BACKGROUND

Although various watersheds have been monitored for different parameters, in general, Guam's freshwater resources are not well studied. The methods of monitoring have seldom been replicated, making comparisons or management as a whole, unrealistic. In the past ten years, the island has experienced a rapid pace of development. Many of these developments, such as golf courses/resorts, encompass some of the island's larger watersheds. There exists very little baseline data by which to assess potential impacts of proposed development to streams, lakes, and coastal areas. Therefore, impact assessment has been difficult without extensive study, and mitigation recommendations remain problematic. Additionally, existing work was completed by off-island consultants over the short term and often techniques applied were developed for temperate areas and not applicable in their entirety, to Guam's tropical freshwater systems. A compilation of freshwater resource information and identification of management and data needs must be established before short and long term management of Guam's watersheds can be planned.

OBJECTIVES

To collate historical data on individual watersheds; develop and implement a long-term monitoring program for freshwater systems, for the purpose of determining: 1) icthyofauna status, 2) biotic and abiotic limiting factors, and 3) present and potential land use impacts.

PROCEDURES

Initially, a list of local watershed information and relevant literature available for Guam, was collected from both local and off-island sources. Simultaneously, suitable monitoring and management systems were also being researched.

The information gathered was reviewed and used to develop a general scope of work toward the implementation of a long-term freshwater monitoring program. As a result, four watersheds were selected for the initial monitoring program. Eventually, the monitoring program will be expanded to include as many watersheds as can be realistically surveyed.

RESULTS

A collection of all the known Guam watershed references has been assembled and a list is available upon request. A general list of watershed information needs has been identified:

1. Faunal surveys of native and introduced species with correct survey methods.

2. Floral surveys.

3. Continuous stream flow data.

4. Consistently collected rainfall data.

5. River mapping and characterization with a consistent method to accomplish it.

The following watersheds were selected for an initial short term monitoring program: 1) the Fena watershed; 2) the Manenggon watershed; 3) the Ylig watershed; and 4) the Pago watershed. These were selected because they represent a range of watershed characteristics, which may help to determine the impacts of the present and proposed land uses.

A technique was needed to survey these watersheds during the initial short-term program and other watersheds during the long term monitoring program. The State of Hawaii has developed a technique, the Modified Quadrat Method, which has potential for local application. The technique was tested in the chosen watersheds and, with a few modifications, determined to be feasible for the initial study, as well the long term monitoring project. Although this technique may not be applicable in its entirety throughout all of Guam's streams, it provides a foundation on which to build during the development of the long-term program.

RECOMMENDATIONS

This is the beginning phase of a long-term freshwater fishery monitoring and management program. This program is important because what occurs in freshwater systems ultimately impacts marine systems. These ecosystems are the foundations for the sportfish resource and therefore essential to maintain and manage as efficiently as possible. It is recommended that this project be continued, that a stream monitoring program be initiated in FY96 and a long-term scope of work be developed.

PROJECT COST

The estimated cost of this project was $15,000.

Report prepared by Georgette Bello Concepcion

JOB PROGRESS REPORT
DEVELOPMENT PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO: F-2-D
SEGMENT: 6

PROJECT TITLE: Marine Fish Habitat Improvement and Aggregating Devices (2323)

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

Fish Aggregating Devices

The Division of Aquatic and Wildlife Resources (DAWR) installed fish aggregating devices (FADs) at five new sites in FY95, bringing the number of operational FADs to nine; a total of twelve has been proposed for the DAWR FAD program. Figure 1 diagrams the approximate location of each of the twelve FAD sites and further designates the status of each site as either "operational" or "permitted but not yet operational". The remaining three sites situated off the eastern windward coast of Guam (45°-Bank, Fadian and Asiga) are scheduled for FAD installation before the end of FY96.

In order to facilitate deployments at the five new sites, as well as to provide for immediate replacement of any FAD lost in the near future, DAWR restocked its inventory of FAD mooring system components and steel buoys. Also received were spools of 3/4" polypropylene strapping bands which were purchased for the purpose of attaching a series of 12-foot ribbons to the 100-foot upper-mooring chain (section between 25-75 feet deep) of each FAD (Figure 2). It is expected that the addition of the ribbons will further enhance the bait-attracting and fish-holding characteristics of the FADs. To date, only the Facpi FAD has been fitted with the ribbons. The other FADs will be fitted later as manpower and sea conditions permit.

Materials necessary for the construction of Indian Ocean-style "rafts" made from strings of purse seine floats were also procured in FY95. The low-resistance, lightweight buoy design of the Indian Ocean raft will be used at the three remaining FAD less sites off the eastern coast (Figure 3).

The Haputo FAD came off station twice in FY95 and were the only buoy losses for the year. The buoy first came off station in November 4, 1994 and was recovered three days later. The recovered buoy was eventually redeployed the following month. There is a possibility that this loss may have been due to shark-bite as the severance point was located approximately 250 feet from the surface. The same buoy came off station again in July 1995, but was not recovered.

The Facpi Point and Cocos Island FADs deployed on December 1, 1992 are still on station and are both expected to exceed the three-year mark. Underwater visual inspections of these FADs earlier in the year led to the discovery that the most significant wear and corrosion on the upper mooring occurs on the hardware, particularly the swivel, immediately beneath the buoy, and that after about a two-year period, enough wear occurs to render the buoy highly susceptible to loss. This observation may also explain why the

Figure 1. FAD Sites

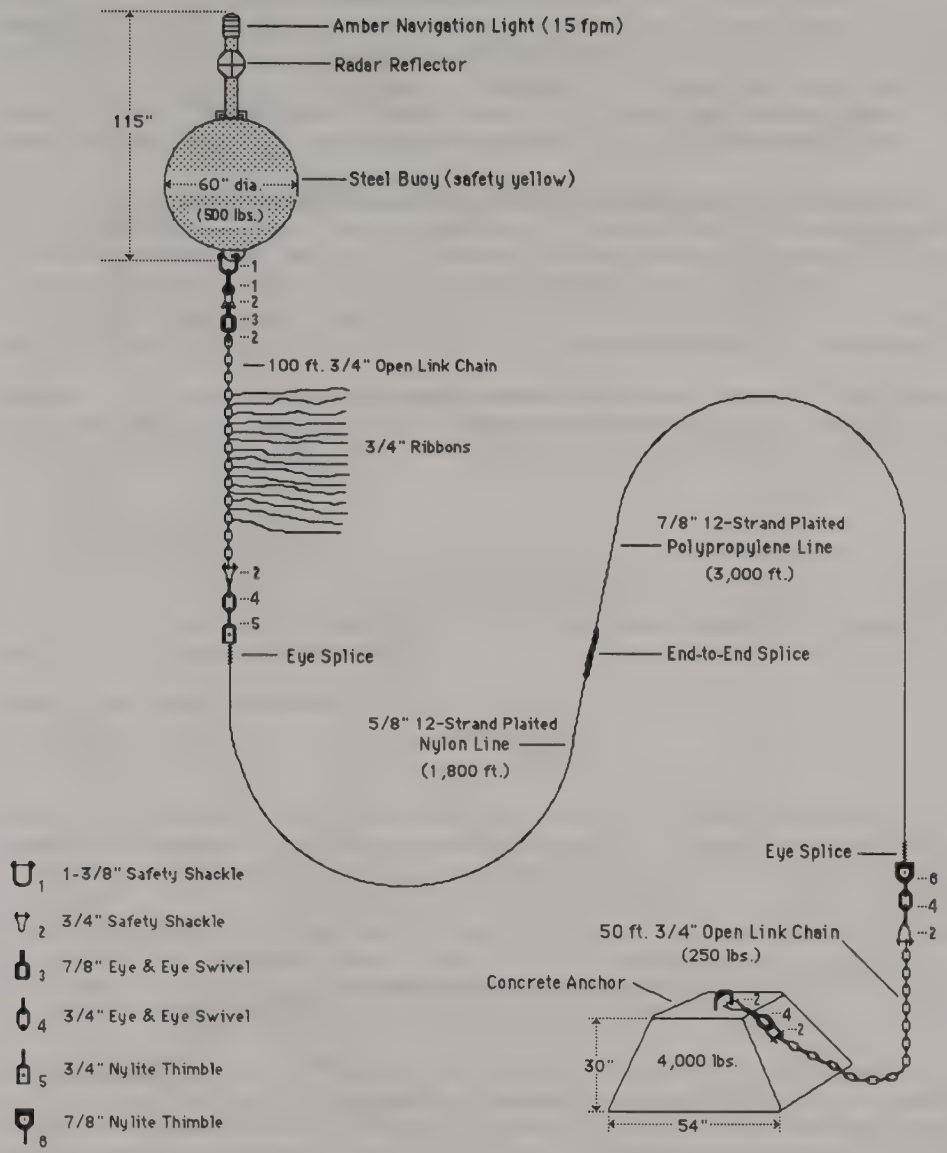

Figure 2. Deepwater Inverse Catenary Loop FAD Design (500 fathoms)

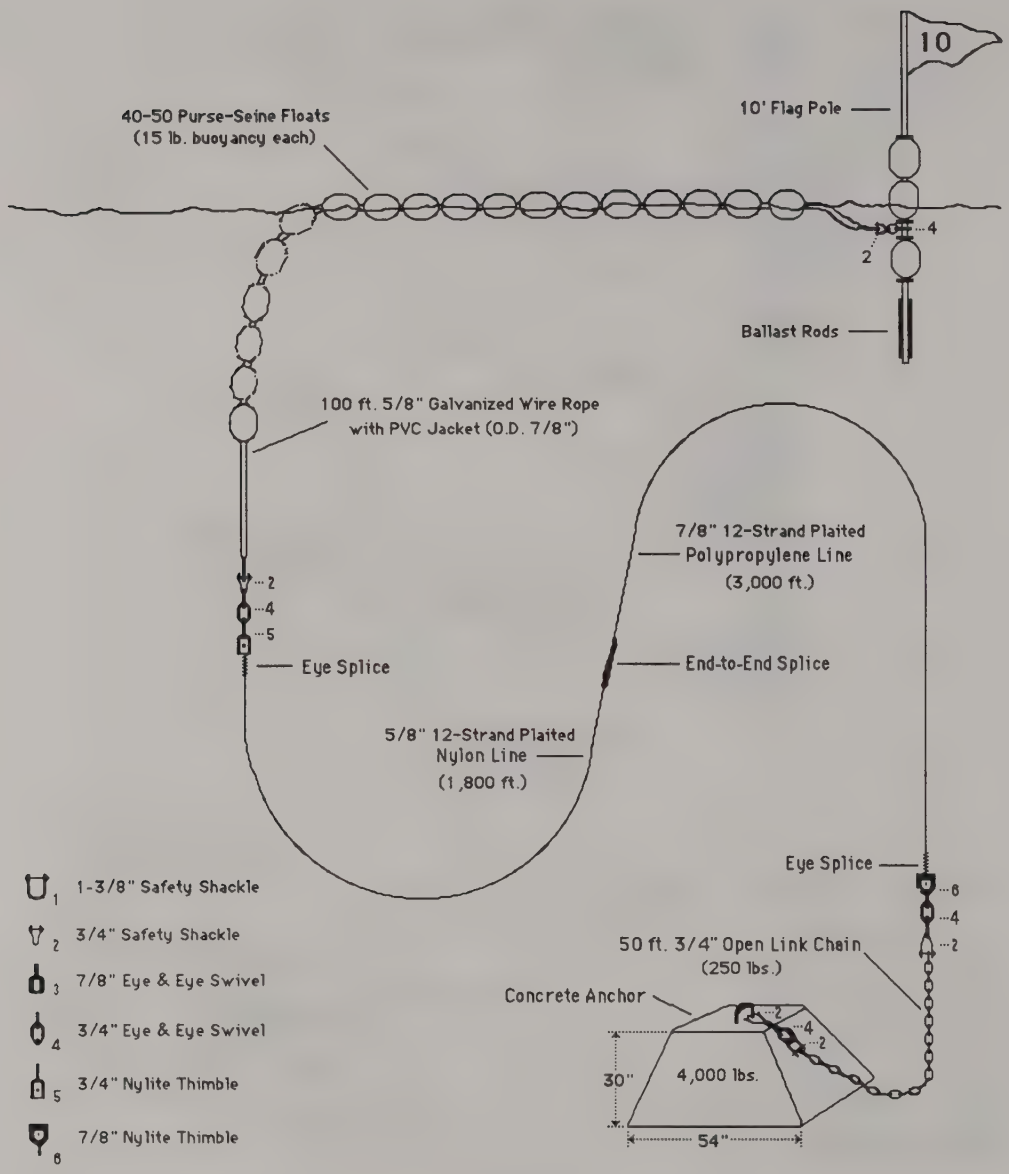

Figure 3. FAD System Using Indian Ocean Raft Design

Adelup and Haputo FADs, both deployed on March 27, 1992, were lost only a couple of months apart, two years later. Given the above, DAWR contracted the current vendor who was hired to conduct FAD deployments, to replace the upper mooring hardware of these two FADs while they were still on station. Because of this replacement procedure, DAWR hopes to extend the lifespan of these buoys an additional two years, and is further considering incorporating the procedure for each FAD every 18 months on station.

Whereas the average FAD time on station for the four original sites was eight months in FY92, the average has more than doubled to over 18 months in FY95, including the two Haputo FAD losses after only 4 and 7 months. With an average lifespan of 5.5 months, the Haputo FAD site may need to be resurveyed to ensure that the bathymetry of the area is not the cause of the unusually high rate of loss this past year. Excluding the Haputo FAD site, the average time on station of the other three sites combined is over 26 months.

Purchase of a 27-foot commercial offshore work vessel was initiated in FY95 to replace the aging and inadequate 19-foot runabout that is currently being used for routine FAD maintenance. Delivery of the new vessel is expected sometime around the second quarter of FY96.

Shallow Water Moorings

No activity was recorded in FY95 for the shallow water mooring project. However, DAWR is recommending that the project be reactivated as a separate development project for FY96.

Fish Aggregating Devices

BACKGROUND

Guam's most productive trolling occurs in the vicinity of offshore banks such as White Tuna Bank, Santa Rosa Reef, Galvez Bank, Eleven-mile Bank and Rota Bank. However, because of their relative distances from the island's marinas and boat launches, these banks are not always easily located by many smaller boats not equipped with GPS or depth sounding gear, or safely accessible during most of the seasonal trade wind periods. Furthermore, the amount of money spent on fuel to reach and return from these areas usually makes the fishing trip an otherwise expensive outing for the average subsistence and recreational fisherman operating vessels less than 20 feet in length.

Fish aggregating devices are effective in attracting and holding pelagic migratory fishes such as yellowfin (*Thunnus albacares*) and bonita (*Katsuwonus pelamis*) tuna, kawakawa (*Euthynnus affinis*), wahoo (*Acanthocybium solandri*), mahi mahi (*Coryphaena hippurus*) and blue marlin (*Makaira nigricans*), in offshore coastal waters (Kanenaka & Higashi, 1989). By strategically placing FADs closer to the island's marinas and other boat launching areas, local subsistence and recreational fishermen are able to take advantage of the FADs to enhance their catch without having to venture out to Guam's offshore banks. Furthermore, FADs can serve as position markers to get to, or return from, various fishing areas including the offshore banks.

Although the FADs will increase the harvest of migratory fishes in Guam's waters, the additional pressure will have no significant impact on the fish stocks because the harvest will remain small-scale and only represent an extremely small percentage of the total amount of migratory fish that pass through Guam's offshore waters.

FADs have no adverse impact on non-migratory pelagic or demersal fish, fauna, wildlife and other natural environmental values, and conform to United States Coast Guard requirements for marking, lighting and standardization of aids to navigation.

Installation of FADs in Guam's offshore coastal waters began in 1979, initially with funding from the Salstonstall-Kennedy Act through the Pacific Tuna Development Foundation. The Guam FAD project is currently being continued as part of Dingle-Johnson/Wallop-Breaux Federal Aid in Sport Fish Restoration program.

OBJECTIVE

The objective is to develop, deploy and maintain fish aggregating devices and shallow water moorings in the near-shore waters off Guam.

PROCEDURES

Construction and Deployment

Procedures for construction and deployment of FADs during FY95, followed the established methods recorded in the FY91, '92 and '94 annual reports. The most recent modification to the design of the buoy system is the use of recently acquired 5-foot diameter spherical steel buoys to replace the depleted stock of nun and can buoys previously used. Actual transportation of FAD system components, final modifications, assembly, loading and eventual deployment were done by the tug company contracted to perform such tasks since FY94. The same contractor was also hired to replace the upper mooring hardware of the Cocos and Facpi FADs on site. The work also involved lifting of the FAD buoy and a length of the mooring chain, securing this portion of the upper mooring to the deck of the vessel, removing the worn shackles, swivel and chain, and then replacing them with new hardware.

FAD Inspection and Maintenance

FAD inspection and maintenance continued to be conducted on a biweekly basis as sea conditions and available manpower permitted. The DAWR FAD program service vessel launches from the Agana Boat Basin for trips to the northern buoys - Adelup, Haputo, Uruno, Number 4 and Ritidian, and then on the following week, from either the Agat Marina or Merizo Pier for trips to the southern buoys - Cocos, Umatac, Nine-Mile and Facpi.

The FAD maintenance routine includes a check on the condition of the navigational light and occasional underwater inspection for shackle, swivel and chain wear of the upper mooring hardware. Previously, a voltage meter was used to measure the battery charge during each light inspection. If the battery pack voltage reading fell between 3.0 and 4.0 volts, the light assembly was replaced because the McDermott system currently in use yields a very dim flash below 4.0 volts, and ceases to flash altogether below 3.0 volts (based on the use of 6-volt super-heavy-duty carbon lantern batteries). Also included in the light maintenance procedure was an inspection for burned-out light bulbs, a defective photocell or a malfunctioning light mechanism. Towards the end of FY95, the procedure was modified to mandatory replacement of a light system after the light had been in place for more than two months. The change in procedure was made after it was determined that the average life expectancy of the battery pack in the navigation light was approximately two months using the regular six-volt carbon lantern batteries that were stockpiled by DAWR. The entire assembly is made watertight with the use of silicone sealant once the battery pack is inserted into the light tube and activated.

RESULTS

Modification and Renewal of FAD Project Permit

On June 21, 1995, authorization was granted (File No. GNWP95--028) by the Army Corps of Engineers (ACOE) to include two new FAD sites in the DAWR program: Number 4 and Umatac/Merizo. The addition of these two sites brought the number of sites in the DAWR FAD program up to twelve, nine of which are currently operational and thus, will not have to be re-permitted in the future when FAD replacements are necessary. However, DAWR may need to request for a renewal of the NWP4 for the remaining three sites - 45-Degree, Asiga and Fadian - if these FAD systems are not installed before the October, 1996 expiration of the previously modified permit. Should it be necessary, no difficulty or delay in renewing the permit is anticipated since the decision for reauthorization would be granted through the local ACOE office on Guam.

FAD Equipment Inventory

The inventory of six 500-fathom systems carried over from the previous year was depleted after the Haputo FAD was replaced twice and FADs were installed at four of the five new sites. Of the ten 500-fathom systems received at the end of May, 1995, one was used for the fifth new site and another for the additional line needed at two sites whose depths exceeded the usual 500 fathoms (Umatac/Merizo: 800 fathoms, Number 4: 600 fathoms), leaving a total of eight 500-fathom mooring systems for FY96 plans. Three will be used for the uninstalled sites off the windward coast and the remaining five as replacements. Also received in FY95 were materials necessary for the construction of ten Indian Ocean-style rafts, which will be utilized to buoy FAD systems located in areas with the roughest sea conditions.

Six of the thirty surplus spherical steel buoys acquired this year were used for the five new sites and one replacement. The remaining twenty-four are slated for navigation light housing modification (addition of section of four-inch galvanized pipe) and refurbishment in FY96, and then stockpiled for future use. Of the twenty 1 and 3/4-ton pyramid-shaped concrete anchors received in FY93, eleven remain in inventory.

FAD Losses

The Haputo FAD came off station twice in FY95 and were the only buoy losses for the year. The buoy first came off station in November 4, 1994 and was recovered three days later after DAWR received word from a local charter boat captain that the buoy was sighted just off the reef edge near Uruno Point. An unusual reversal in wind pattern from a northeasterly to a southwesterly direction, at the time the FAD came off station, was largely responsible for the buoy being blown back to the island rather than away, as is usually the case. Since there were no other buoys left at the time, the recovered buoy was refitted a second time and eventually redeployed the following month. There is some speculation that this loss may have been due to shark-bite as the severance point was located approximately 250 feet from the surface (100 feet of chain followed by 150 of nylon line). The same buoy came off station again in July 1995, but was not recovered.

The Facpi Point and Cocos Island FADs deployed on December 1, 1992, are still on station and are both expected to exceed the three-year mark. Underwater visual inspections of these FADs earlier in the year, led to the discovery that the most significant wear and corrosion on the upper mooring occurs on the hardware (particularly the swivel) immediately beneath the buoy, and that after about a two-year period, enough wear occurs to render the buoy highly susceptible to loss. This observation may also explain why the

Adelup and Haputo FADs that were both deployed on March 27, 1992, were lost only a couple of months apart two years later.

Given the above, DAWR contracted the current vendor hired to conduct FAD deployments, to also replace the upper mooring hardware of these two FADs while they were still on station. Because of this replacement procedure, DAWR hopes to extend the lifespan of these buoys an additional two years, and is further considering incorporating the procedure for each FAD after it has been on station for at least 18 months. If successful, this maintenance procedure could result in a doubling of the expected average FAD time on station from 24 months to 48 months.

Whereas the average FAD time on station for the four original sites was eight months in FY92, the current average has more than doubled to over 18 months in FY95, including the two Haputo FAD losses after only 4 and 7 months. With an average lifespan of only 5.5 months for the last two deployments, the Haputo FAD site may need to be resurveyed to ensure that the bathymetry of the area is not the cause of the high rate of loss this past year. Were the Haputo FAD site not included in the estimation, the average time on station of the other three sites combined is over 26 months, which exceeds the target FAD lifespan of 24 months.

FAD Deployments

Seven deployments were made in FY95 at a total cost of $13,851.67, or an average of $1,978.81 per FAD deployment. The average cost was up $646.73 from FY94's average cost and is attributed primarily to predeployment welding and painting services (pipe-fitting for navigational light housing and topcoat paint application) for the new spherical buoys. The first deployment was on December 28, 1994, to replace the Haputo FAD. The second and third deployments occurred on July 13, 1995 to replace the Haputo FAD once again, and then to install the new Uruno site FAD. Deployments four and five, Umatac/Merizo and Nine-mile, took place on August 24. The last two of the year were Number 4 and Ritidian, which were deployed on the following day, August 25, 1995.

Costwise, DAWR has been fortunate in being able to rehire the local tug company that conducted the FY94 deployments because the previous contractor hired in FY92, charged a flat rate of $4,500.00 per system, which would have amounted to a total of $31,500.00 for the year. The latter contractor has since permanently gone off-island and thus leaves the current vendor as the sole-source for the FAD services needed for the DAWR program. DAWR intends to submit another blanket requisition to cover such FAD-related services in FY96, and will further request that the current company once again be awarded a purchase order on the basis of experience, convenience and cost, as well as being a sole-source provider.

Buoy Modifications

In order to prevent larger vessels from colliding into the FADs, radar reflectors (Davis "Echomaster" Standard #152) were purchased for modification and installation on DAWR FADs. DAWR has found that even without radar reflectors, the steel buoys can still be detected by a vessel's radar within a one to two mile radius (using deployment vessel's radar). Nevertheless, DAWR still intends to fit each FAD on station with a radar reflector to further enhance radar detectability. The installation of radar reflectors began with the Facpi Point and Cocos Island FADs on September 3, 1993 (buoys deployed December 1, 1992), and later installed on the Adelup Point and Haputo Point FADs on September 15, 1993 (buoys deployed March 27, 1992, and have since been lost and replaced). Radar reflectors are installed after buoy deployments since previous experience has shown that the

radar reflectors are usually damaged during the buoy release procedure. Presently, the Facpi FAD is the only buoy that has a radar reflector installed. The remaining eight will be fitted with radar reflectors in early FY96.

The FY94 recommendation to install counterweights on the new inventory of spherical buoys was nullified after it was discovered that a prototype buoy would remain upright with only 50 feet of 3/4" chain, even with a 42" section of 4" galvanized pipe welded to the top, and a fully functional navigation light installed in it. However, a decision was also made to continue the use of a 100-foot length of chain instead of 50 as an added measure of protection from damage caused by hooks and lines.

FAD System Cost Analysis

The FY93 through FY95 cost comparison per FAD system, including deployment, is listed in Table 1 below. Between FY93 and FY94 a 29% reduction in total cost per FAD system, was realized with the selection of a new vendor to conduct FAD deployments. In FY95, the average total cost per FAD system increased by 4% over the previous FY94's total cost, due in large part, to the purchase and shipping of 30 surplus steel buoys from Honolulu, and partly to costs incurred for the predeployment pipefitting and topcoat application of these newly acquired buoys.

Table 1. FAD System Cost Analysis FY93 - FY95

ITEM	UNIT COST		
	FY93	FY94	FY95
buoy	$ 500.00	$ 500.00	$ 518.50
anchor block	$1,142.86	$1,025.00	$1,025.00
mooring system	$5,186.16	$5,186.16	$4,854.00
buoy light	$ 171.29	$ 171.29	$ 242.93
deployment	$4,500.00	$1,332.08	$1,978.81*
TOTAL COST:	**$11,500.31**	**$8,214.53** 29% reduction from FY93	**$8,619.24** 25% reduction from FY93

* includes predeployment pipefitting and application of topcoat paint.

RECOMMENDATIONS

Fish Aggregating Devices

FADs remain quite popular with local fishermen and are most noticed when the systems are no longer on site. The project should be continued with the following recommendations:

1. Deploy FADs at 45-Degree, Fadian and Asiga sites using Indian Ocean rafts to buoy the systems.

2. Install radar reflectors on each operational FAD.

3. Use pre-wired and pre-packaged alkaline battery packs to minimize the amount of time spent on preparing battery assemblies, as well as to reduce the frequency of maintenance trips necessary for replacement of navigational lights (alkaline batteries: 4-6 months, regular carbon cells: 1-2 months). Also explore use of solar-powered systems to extend battery life from several months to several years.

4. Reorder enough mooring equipment and supplies for five additional deployments (inventory of ten 500-fathom systems).

5. Request reissuance of blanket purchase order to conduct FAD-reissuance deployments at remaining three FADless sites and insure timely replacement of lost FADs. Contract services should also include predeployment welding, painting and onsite replacement of upper mooring hardware when necessary.

6. Complete procurement of a larger, more seaworthy commercial-duty vessel to conduct FAD maintenance procedures and vehicle capable of towing the new vessel.

7. Attach ribbons of plastic strapping material to upper mooring chain of each FAD to enhance bait and fish-holding characteristics of the FAD.

8. Complete modification and refurbishment (attachment of 42" section of 4" galvanized pipe for navigation light housing and painting) of remaining 24 steel buoys.

9. Split program to "FAD Deployments at New Sites" and "Operation and Maintenance of FADs at Existing Sites".

PROJECT TIME LINE

FADs

	FY96											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
Deployment of Indian Ocean FADs						X	X	X	X			
Construct and install radar reflectors	X	X	X	X								
Purchase alkaline battery packs		X	X	X								
Purchase backup mooring systems									X	X	X	X
Establish blanket P.O. for buoy deployments	X	X	X									
Purchase vessel & towing vehicle	X	X	X	X								
Attach strapping strips to buoy chains			X	X	X	X	X					
Modify and refurbish buoys		X	X	X	X							

Shallow Water Moorings

The popularity of water-related activities has resulted in an increase in damage to coral reefs near popular sites caused by the setting of anchors. The installation of mooring buoys is one means of reducing such damage. However, due to the amount of time that has lapsed since the need for mooring buoys was originally identified, DAWR recommends that the project be reactivated as a separate development project in FY96 to prevent any further delays in the deployment of the shallow water mooring buoy systems.

PROGRAM COSTS

FADs

The estimated cost for the FAD project for FY95 is $160,693.88.

Shallow Water Moorings

The estimated cost for the shallow water mooring project is $0.

LITERATURE CITED

Hensley, R. 1990. Construction of Fish Aggregation Devices and Development of a Shallow Water Mooring System. Annual Report Fiscal Year 1990, Division of Aquatic and Wildlife Resources, Department of Agriculture, Government of Guam.

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Report prepared by: Andrew A. Torres

JOB PROJECT REPORT
DEVELOPMENT PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO: F-2-D
SEGMENT: 7

JOB TITLE: Development of Small Boat Launching Facilities (2332)

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

Plans to construct small boat ramp facilities on the east side of Guam have been ongoing. The south side of Ylig River is currently used as a makeshift ramp, and has been selected as a potential site because of its historical use as a launching site for boats fishing the east side. The property is privately owned by Tomen Corporation; initial contact has been made with the owners who have expressed their willingness to cooperate with the proposed project. Schematic diagrams of a small boat ramp facility at Ylig River are currently being reviewed by staff before they are presented to the property owners.

The Merizo pier and boat ramp facility have been used extensively by the public. During FY94 and FY95, the pier was assessed for damage due to wear and tear and vandalism. Repair of the corroded and damaged ladders has been completed, and plans for other repair work will be completed in FY96.

OBJECTIVE

Redesign and renovate the existing public boat launching ramp located in Merizo and develop plans for boat ramps at two sites on the east side of the island.

RESULTS

The southern side of Ylig River has been identified as a potential boat ramp facility because of its historical use as a makeshift ramp. The adjacent property owner, Tomen Corporation, has expressed its willingness and interest in cooperating with the Division of Aquatic and Wildlife Resources' (DAWR) plan to place a boating ramp and parking facility. Tomen Corporation has requested a development plan and facility drawings for the evaluation prior to giving their approval to construct a boat ramp facility on their property. The Department of Public Works (DPW) has also been contacted to address access, traffic, and highway expansion concerns and has tasked personnel from the Building Permits Section to assist with this proposed project. Final plans for the proposed Ylig small boat ramp facility are pending Department of Agriculture's approval.

During FY94, the Merizo Pier was assessed for damage to the galvanized ladders from corrosion and items missing from the pier which include lag screws and cleats. The cleats were also determined to be too small for the boats using the pier. The missing lag screws and larger cleats have already been obtained and will be placed on the pier during the early part of FY96. The damaged ladders were repaired during FY95. Other damage assessed during FY95 include worm infestation of the lower rubber bumpers so that most of the lower rubber bumper sections have been removed and salvaged; a section of the upper rubber bumper was pulled off the concrete piling it was bolted to; and, the electrical wiring for the outer lights on the Merizo Pier has been damaged from saltwater corrosion, and

vandalism. The proposal for repairing the damaged bumpers has been approved by the Department of Agriculture and is pending approval from the Department of Administration.

The Merizo boat ramp was damaged beyond repair and determine too small to accommodate current use. The Merizo parking facility is cracked in several places and the number of spaces should be increased to maximize the efficiency of the parking facility. A proposal to remove the old ramp, construct a new double boat ramp, and reconstruct the parking facility, has been approved by the Department of Agriculture and is pending approval from the Department of Administration.

Plans are ongoing for the construction of a small boat ramp facility at Inarajan Bay to be funded by the Guam Power Authority. The Division of Aquatic and Wildlife Resources (DAWR) has been tasked with writing the Environmental Impact Assessment (EIA) for the project. Federal Aid funds have been used to conduct terrestrial and marine flora and fauna assessments of the proposed boat ramp site to gather information to formulate the EIA. The EIA will be completed during FY96.

The ramps at the Agana Boat Basin have been assessed for repair work. The grooves on both the ramps have been worn down and have numerous cracks in them. Vehicles launching and retrieving boats have experienced problems with traction; in one instance, a vehicle accidentally submerged from a lack of traction. A proposal to overlay the ramp to construct new grooves has been developed.

RECOMMENDATIONS

Plans for constructing a small boat ramp facility at Ylig are pending approval by the Department of Agriculture, which will then be submitted to the Tomen Corporation. Once final approval is obtained, DAWR will begin negotiations with Tomen Corporation. The Department of Public Works will be consulted for this input on access and traffic consideration and highway expansion plans. Plans for the repair of the Merizo Pier and reconstruction of the Merizo boat ramp and parking facility have been approved by the Department of Agriculture and are pending approval from the Department of Administration. Repair work on Merizo Pier, such as replacing missing lag screws and missing cleats should be done as soon as possible since these items have already been obtained. Other small boat ramps should be evaluated for other enhancement and repair projects to improve the current facilities.

PROJECT COST

The cost of the project this fiscal year is $16,545

Report Prepared by: Thomas Flores, Jr.

JOB PROGRESS REPORT
DEVELOPMENT PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: F-2-D
SEGMENT: 9

JOB TITLE: Development of Inshore Fishing Access Facilities (2331)

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

During FY95, the necessary documents for constructing fishing platforms were submitted for environmental review by both local and federal government agencies. A work request to initiate the job has been submitted to the Department of Public Works. After the governmental review is complete and the funding released, the project will be put out on.

BACKGROUND

The historical, traditional use and design of fishing platforms has been reviewed in previous fiscal year reports (Kruckenberg, 1989 - 1994). Because inshore fishing continues to be a popular activity, there is a real need to provide greater accessibility to inshore fishing areas and improve safety in areas that are typically unsafe.

OBJECTIVE

To plan, design and construct inshore fishing access facilities (reef flat platforms and cliff platforms) on the windward coast of Guam and research the possibilities of alternate sites on the leeward coast.

PROCEDURE

The Division of Aquatic and Wildlife Resources (DAWR) has been actively pursuing the planning, design, site selection, environmental review and construction of reef flat fishing platforms. The primary focus during FY95 was the preparation and submittal of documents for environmental review by the governmental agencies.

RESULTS

The environmental impact assessment and other documents necessary for review by the territorial and federal government have been sent out for comment. Preparations are being made to contract construction through the bidding process, with the Department of Public Works as contract administrator.

DISCUSSION

The permitting process has been initiated and no negative comments have been received.

RECOMMENDATIONS

This program has valuable fishing application for Guam while providing a safety factor and enhancing fishing opportunities. It is therefore recommended that this job be continued and that the project commence construction within the next fiscal year.

PROGRAM COSTS

The estimated cost of the "Development of Inshore Fishing Access Facilities" was $15,000.

Report prepared by: Wayne Kruckenberg

JOB PROGRESS REPORT
DEVELOPMENT PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: F-2-D
SEGMENT: 10

JOB TITLE: Masso Reservoir Restoration (2322)

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

A conceptual general design and scope has been prepared for the Masso Reservoir Project. This project remained relatively inactive during FY95 because other projects had a higher priority.

BACKGROUND

The project will enhance sportfishing opportunities and/or protect the freshwater finfish resources at Masso Reservoir. The history of the Masso Reservoir Project was outlined in previous job progress reports (Kruckenberg, 1993 and 1994). The project involves dredging of the reservoir, rehabilitation of the water control gate structure, development of the area for public access and the shoreline for fishing. In addition, sediment basins will be constructed in the Masso Valley watersheds.

OBJECTIVES

1. To conduct an assessment of fauna, habitat and facilities on the old Masso Reservoir project site.

2. To utilize the assessment information and review the original project plan to develop a scope of work to restore the Masso Reservoir Project.

RESULTS

A draft conceptual design and scope of work has been prepared for the Masso Reservoir Project. Because other projects had higher priority, this project has remained relatively inactive during the fiscal year.

RECOMMENDATIONS

This program has valuable freshwater fishing potential for Guam while providing a safety factor and enhancing fishing opportunities. It is recommended that this job be continued to develop a freshwater reservoir on Guam for sport fishing.

PROGRAM COSTS

The estimated cost of the Masso Reservoir restoration project is $7,498.

Report prepared by: Wayne Kruckenberg.

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

JOB TITLE: Giant Clam Transplantation

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

Mature giant clams (*Tridacna derasa*) transplanted to sites in Sasa Bay (sites A and B) and Jade Shoals (sites C and D) during FY89, are periodically monitored. Mature giant clams were also transplanted to the Glass Breakwater (sites E and F) during FY90, but were all poached by mid-June 1990. Of the 100 five-year old clams transplanted in FY89, only 22 remain. The clams transplanted at the inner area of Sasa Bay (site A) were observed to have significantly slow growth rates, probably due to the high silt levels at site A. High silt levels also made it difficult to locate the clams at site A. These clams were transplanted to site B on April 10, 1995. All remaining clams were measured and checked for signs of parasitism, predation, or poaching on April 10, 1995. All remaining clams are now located at a depth of 10 meters.

OBJECTIVES

To reestablish a greater variety of giant clams on Guam's reefs.

PROCEDURES

The procedure for site selection, processing, and field placement, and monitoring of giant clams was reported in FY89; the growth rate of the clams was reported in FY92. Annual visits were made to monitor and measure the clams. The status regarding growth, predation, depth, and general health has been recorded and reported annually. During FY95, the clams in Sasa Bay, site A, were transplanted to Sasa Bay, site B since high silt levels at site A significantly lowered growth rates and made it difficult to locate the clams.

RESULTS

The last report on the clam project was made in FY92. The clams were measured once during FY94 and once during FY95.

At the end of FY94, all clams experienced positive growth except for one at site C, which measured 3 mm less (Table 1). The clams located at site A, at a depth of 4 meters, were not located due to high silt levels in the water. One of the clams at a depth of 10 meters at site A had died. The Mean Daily Growth Rate, (growth rate in mm) from the time the clams were last measured was significantly higher for clams at Sasa River, site B, (0.06) than those at sites A (0.02), C (0.01), and D (0.01). However, the Total Daily Growth Rate, (growth rate in mm) since initial transplanting and the Adjusted Annual Growth Rates are almost identical for sites B, C, and D, and approximately three times higher than the clams at site A. The lower growth rates at site A may be due to the high levels of silt in the water which reduce the amount of sunlight available for photosynthesis. All the clams measured were located at a depth of 10 meters.

Table 1: Growth (mm) of transplanted *Tridacna derasa* between October 16, 1991 or †November 19, 1992 and August 31, 1994. Mean Daily Growth rate represents growth since the last reported measurement. Total Daily Growth Rate is growth rate from transplanting in FY89.

Site	# Clams	# Days††	Growth Range	Mean Daily Growth Rate	Total Daily Growth Rate	Adjusted Annual Growth
A	5	1052	4-53	0.02	0.02	8.72
B†	8	651	19-90	0.06	0.07	26.28
C	5	639	(-3)-21	0.01	0.07	26.02
D	5	639	1-17	0.01	0.07	25.01

†† Since last measured.

During FY95, the clams from Sasa Bay, site A were moved to Sasa Bay, site B due to high silt levels, low growth rates, and difficulty in locating the clams at site A. The clams at Sasa Bay, site A at a depth of four meters were not found and are presumed to have been poached.

All clams except for four were measured to have positive growth. However, the four clams were measured 1-2 mm less after 222 days and the negative growth may have been due to error in measurement. These clams could be considered to have experienced little to no growth, rather than negative growth. There is a significant difference in the Mean Daily Growth and Adjusted Annual Growth rates between the clams at site A and sites B, C, and D, while these values are similar between the clams at sites B, C, and D (see Table 2). The clams at site A had a Mean Daily Growth rate of 0.002, while sites B, C, and D had a Mean Daily Growth rate ranging from 0.020 to 0.030. The clams at site A had an Adjusted Annual Growth rate of 8.49, while the clams at sites B, C, and D had Adjusted Annual Growth rates ranging from 23.46 to 24.19.

Table 2: Growth (mm) of transplanted *Tridacna derasa* between August 31, 1994 and April 10, 1995.

Site	# Clams	# Days††	Growth Range	Mean Daily Growth	Adjusted Annual Growth
A	5	222	(-1)-10	0.002	8.49
B	8	222	(-2)-11	0.020	24.19
C	5	222	(-1)-10	0.021	24.00
D	5	222	3-16	0.030	23.46

†† Since last measured.

The growth of the surviving clams at all four sites from initial transplanting are listed in Table 3. All the remaining clams are at a depth of ten meters. The clams at sites B, C, and D show similar Mean Total Growth, Mean Daily Growth Rates, and Mean Yearly Growth Rates. The clams at site A, probably due to lower photosynthetic activity due to higher silt levels in the water, had a Mean Total Growth, Mean Daily Growth Rate, and Mean Yearly Growth Rate approximately a third that of sites B, C, and D. The clams at site A were moved to site B and will be measured during FY96 to observe if an increase in growth rate occurs.

Table 3: Total Growth Rate of transplanted *Tridacna derasa* between September 20, 1989 or September 28, 1989 and April 10, 1995.

Site	# Clams	Mean Total Growth	Mean Daily Growth Rate	Mean Yearly Growth Rate
A	5	47.20	0.02	8.49
B	8	134.63	0.07	24.19
C	5	133.00	0.07	24.00
D	5	130.00	0.06	23.46

RECOMMENDATIONS

It is recommended that this project remain active as long as the transplanted clams are living. Since most of the clams from the initial transplanting have been poached, it is not recommended to obtain new clams until a more suitable area for seeding or a marine preserve with adequate enforcement is established. During FY95, the remaining sites should be photographically mapped and their location drawn in detail to facilitate identification of individual clams and enable finding the sites easier.

Report prepared by: Thomas Flores, Jr.

GUAM COMMERCIAL FISHERIES

STATE: Territory of Guam

JOB TITLE: Commercial Fisheries on Guam

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

Commercial landings of locally caught fish are an important component of our total fisheries catch. We continue to monitor the resource by collecting and processing the data. The commercial fisheries data for this fiscal year was sent to NMFS in Hawaii for a final quality check. The summary data is available from NMFS or our office.

BACKGROUND

The commercial fisheries program was established to learn more about the fishery resource being caught and sold on Guam. The program was initiated by the National Marine Fisheries Service (NMFS). Initially, data was only collected from the Guam Fishermen's Cooperative in Agana. Six other buyers have participated in the program since 1979. Because it became increasingly difficult for NMFS to manage the data collection program from Hawaii, the Division of Aquatic and Wildlife Resources has coordinated the data collection since January 1990. This responsibility has slowly increased to the point where we handle the majority of the program.

OBJECTIVES

To monitor, analyze and report on locally caught fish sales and related activities through the collection of vendor receipts.

PROCEDURES

There are two cooperating vendors presently providing receipt data to the program. The Guam Commercial Fisheries receipt books are provided to each vendor in the program. Each receipt asks for information to be completed by each cooperating vendor while the catch is being purchased. On each receipt, there is a space provided for the name of the person providing the catch, fisherman number, date, number of fishermen, hours fished, fishing location, and fishing method. The fishing location number and fishing methods code are determined by using the chart provided on the inside of each receipt book cover. The catch information is broken down into six primary areas: (1) Bottom fish, (2) Reef fish, (3) Troll (pelagic) fish, (4) Invertebrates, (5) Seaweed, and (6) Imported Items. Each item has a code number to identify the fish, invertebrate, or seaweed. Space is provided to indicate the number of items, total weight, price paid per pound, the value of the items, the total value of the transaction and any additional remarks. There are three copies of each receipt with one for the person representing the catch, one for the vendor, and one for processing the information into the computer data base.

The vendors were visited on a regular basis to monitor the completion of the forms, collect completed receipt books, to check on errors in the data and insure that they had a supply of receipt books. A logbook was used to record when a receipt book was initially

given and received back from a vendor. When a receipt book was returned, the name of the vendor was indicated on the outside at the top to indicate which vendor completed the receipt book.

RESULTS

During FY95, forty-one receipt books were collected from the cooperating vendors. The data was input cross-checked for accuracy. The receipt books were transmitted to the NMFS office at Hawaii for data quality control checks. The data is presented in the "Fishery Statistics of the Western Pacific" and the bottom fish and pelagic plan monitoring team annual reports for Guam.

DISCUSSION

Since the initiation of the commercial fisheries program, our responsibilities have slowly increased. During FY95, the office received a computer from NMFS that has assisted us with data input and performing quality control on the data. This past FY, a fisheries biologist went to the NMFS office in Honolulu to receive training with the computer and assist in developing the computer program for the commercial fisheries data collected on Guam.

At this time, the cooperators with the commercial fisheries program are voluntary. Based on our observation of commercial sales, we cover an estimated 60% of the total coverage of locally caught fish. One of our vendors has dropped out of the program and are currently working to replace them with another one. We have not been monitoring the vendors selling imported fish from the Philippines and/or Micronesia. The primary goal of the program is to gather as much information as we can about our fisheries resource and have the collected data represent a complete picture of the locally caught and sold fish.

RECOMMENDATION

A law or regulation be passed that would require that people use an identification number in selling their catch to vendors and for vendors of local fish products to use our commercial fisheries receipts in their business transactions. This would give a more comprehensive view of the commercial fisheries activity around Guam.

Report prepared by: Wayne Kruckenberg

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: W-1R-3
SUBPROJECT NO: W-1
STUDY NO.: 1
JOB NO.: 1

JOB TITLE: Determination of Current Population Size and Distribution of Guam Deer (1460, 1430)

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

Official logs with deer harvest statistics for Andersen Air Force Base (AAFB) were examined and revealed a total of 2,876 hunter sorties, a harvest of 55 deer, and a harvest rate of one deer per 21.7 hunter-days. At the Naval Computer and Telecommunications Area Master Station (NCTAMS), there were 1,178 hunter sorties, a take of 17 deer, and a harvest rate of one deer per 22.9 hunter-days. Population trend data obtained with spotlight counts on AAFB and the U.S. Naval Magazine (NavMag), showed no significant changes ($P > 0.10$) in deer numbers. Efforts to revise Guam's existing deer hunting regulations were started in an attempt to liberalize restrictions on the take of this species. Counts of feral water buffalo at NavMag showed a significant decrease ($P < 0.01$) during FY95.

BACKGROUND

The Guam deer (*Cervus mariannus*), or Philippine sambar deer, has been under investigation by the Division of Aquatic and Wildlife Resources (DAWR) since 1961 (DAWR 1961-1994). Preliminary information on distribution, population trends, and biology appeared in Wheeler (1979). Deer hunting statistics have been compiled annually since 1968 through hunter reporting procedures. Currently, Guam has a split deer hunting season, with the first segment running from October 1 to December 31, and a second segment occurring from September 1-30. There is a bag limit of one antlered deer (buck only) per season, per license holder, exclusive of any special harvest.

OBJECTIVES

To determine the current size and distribution of the deer population on Guam and to monitor population trends.

PROCEDURES

1. Conduct four spotlight counts per month from May to July on AAFB and one count per month in other months. Conduct monthly spotlight counts on NavMag, and periodic counts elsewhere on the island.

    a. Record number, sex, age, and group composition.

    b. Analyze count data and compare with previous data to discern population trends.

2. Collect hunting statistics via a hunter questionnaire. Analyze statistics for changes in hunter kill, effort, and hunting location.

3. Collect biological data from animals killed during the hunting season and from incidental sources such as road kills or confiscated animals.

RESULTS

Deer Hunting Statistics

Deer hunting data for FY94 and FY95 were generated from hunter questionnaire responses and are presented in Tables 1 and 2. Questionnaires did not differentiate between gun and bow hunting and the data presented here are combined for the two types of hunting. In FY94, an estimated 431 hunters spent 8,749 days to harvest a total of 160 deer, with an estimated 54.7 hunter-days (one hunter-day = 8 hours) expended per deer taken. In FY95, an estimated 337 hunters spent 6,174 days to harvest 67 deer, with an estimated 92.1 hunter-days needed per animal taken. Data for both years are based on fairly small samples of returned questionnaires. In both years, questionnaires were distributed for the first time by hunting license vendors at the time when hunters purchased their licenses. In previous years, the DAWR had mailed questionnaires directly to hunters at the close of each fiscal year. This change in procedure may account for the lowered rates of questionnaire returns.

Table 1. Summary of island-wide deer hunting statistics for FY94 derived from hunter questionnaires distributed with game licenses during FY95.

a.	Total license sales for all game species	750
b.	Number of questionnaires distributed	-*
c.	Number of questionnaires returned	47
d.	Percent queried license buyers that hunted any species	-
e.	Number of reporting license buyers that hunted any species	32
f.	Percent of license buyers that hunted	68.1%
g.	Estimated total number of legal hunters	511
h.	Number of reporting hunters that hunted deer during the regular season	27
i.	Percent of reporting hunters that hunted deer during the regular season	84.4%
j.	Number of deer taken by deer hunters	10
k.	Hunter success	37.0%
l.	Hunter-days expended by reporting deer hunters	549
m.	Average number of days spent per reporting deer hunter	20.3
n.	Estimated total number of legal deer hunters	431
o.	Estimated total deer take	160
p.	Estimated total number of days spent hunting deer	8,749
q.	Number of days spent hunting per deer taken	54.7

*actual number of questionnaires distributed by vendors is unknown.

Table 2. Summary of island-wide deer hunting statistics for FY95 derived from hunter questionnaires distributed with game licenses during FY95.

a.	Total license sales for all game species	822
b.	Number of questionnaires distributed	-*
c.	Number of questionnaires returned	61
d.	Percent queried license buyers that hunted any species	-
e.	Number of reporting license buyers that hunted any species	37
f.	Percent of license buyers that hunted	60.7%
g.	Estimated total number of legal hunters	499
h.	Number of reporting hunters that hunted deer during the regular season	25
i.	Percent of reporting hunters that hunted deer during the regular season	67.6%
j.	Number of deer taken by deer hunters	5
k.	Hunter success	20.0%

l.	Hunter-days expended by reporting deer hunters	458
m.	Average number of days spent per reporting deer hunter	18.3
n.	Estimated total number of legal deer hunters	337
o.	Estimated total deer take	67
p.	Estimated total number of days spent hunting deer	6,174
q.	Number of days spent hunting per deer taken	92.1

*actual number of questionnaires distributed by vendors is unknown.

Records of hunting activity and harvest were kept by officials at AAFB and NCTAMS during the deer hunting season (Table 3). According to hunter logs from AAFB, 830 hunter-days (2,002 sorties; gun hunting only) were expended at Northwest Field (NWF) and resulted in the harvest of 52 deer. The Conventional Weapons Storage Area (CWSA) recorded 145 hunter-days (298 sorties; bow hunting only) with no deer taken. Hunting areas on the rest of the base (Tarague basin, landfill area, and Andersen South) recorded 220.1 hunter-days (576 sorties; primarily bow hunting) with three deer harvested. In Area 50 of NWF, a special control hunt from March to June resulted in the take of eight additional deer. At NCTAMS, 389.3 hunter-days (1,178 sorties; gun and bow hunting) were expended, with 17 deer killed.

Table 3. Hunter effort and deer taken on AAFB and NCTAMS during FY95, based on official hunter logs.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Andersen Air Force Base													
Northwest Field (gun hunting only)													
No. hunter sorties	449	758	329									466	2002
No. hunter days (8 hr)	220.9	260	122.5									226.6	830.0
Deer taken	16	13	7									16	52
Days effort/take	13.8	20	17.5									14.2	16.0
CWSA (bow hunting only)													
No. hunter sorties	127	137	area									34	298
No. hunter days (8 hr)	61.5	68.9	closed									14.6	145
Deer taken	0	0										0	0
Days effort/take	-	-										-	-
Other Areas of the Main Base (primarily bow hunting)													
No. hunter sorties	225	161	172									18	576
No. hunter days (8 hr)	94	57.6	60.6									7.9	220.1
Deer taken	0	1	1									1	3
Days effort/take	-	57.6	60.6									7.9	73.4
NCTAMS (gun and bow hunting)													
No. hunter sorties	228	287	321									342	1178
No. hunter days (8 hr)	111.9	70.9	64.9									141.6	389.3
Deer taken	4	5	3									5	17
Days effort/take	30	14.2	21.6									28.3	22.9

Spotlight Count Trends

On AAFB, deer numbers observed during counts in May-July, which is considered the best counting period of the year (DAWR 1984), were not significantly different from those recorded in May-July FY94 (Mann Whitney U-Test, $U' = 39$, $n_1 = 8$, $n_2 = 9$, $P > 0.10$)

(Table 4). During these months, the average number of animals seen per count decreased from 75.9 in FY94 to 69.5 in FY95. Likewise, numbers observed throughout the year did not vary statistically from those of the previous year (Mann Whitney U-Test, $U' = 136.5$, $n_1 = 17$, $n_2 = 16$, $P > 0.10$). The average number of deer seen per count (October-September) decreased slightly from 64.4 in FY94 to 62.7 in FY95. The largest single nightly count on AAFB increased from 99 (13.8 deer/km) in FY94 to 97 (15.2 deer/km) in FY95.

Table 4. Composition of deer seen during spotlight counts on AAFB, FY95.

Class	Ct	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	Mean	SD
Unclassed	1		1	1	7	2	3	4	6	0	0	2		45	2.8	2.5
buck	2									5	1					
	3									0	2					
	4									3						
	5									8						
	Ave		1	1	7	2	3	4	6	3.2	1	2				
Spike	1		2	1	3	3	7	6	3	4	3	3		55	3.4	2.0
	2									7	1					
	3									6	1					
	4									3						
	5									2						
	Ave		2	1	3	3	7	6	3	4.4	1.7	3				
2 pt	1		0	1	1	3	2	5	1	0	1	0		24	1.5	1.4
	2									1	1					
	3									3	0					
	4									3						
	5									2						
	Ave		0	1	1	3	2	5	1	1.8	0.7	0				
3 pt	1		0	0	2	1	5	5	6	2	3	2		62	3.9	2.6
	2									4	5					
	3									8	5					
	4									8						
	5									6						
	Ave		0	0	2	1	5	5	6	5.6	4.3	2				
4 pt	1		0	0	0	0	0	0	0	1	0	1		6	0.4	0.6
	2									2	0					
	3									0	1					
	4									0						
	5									1						
	Ave		0	0	0	0	0	0	0	0.8	0.3	1				
Doe	1		11	17	21	16	38	24	49	18	16	32		425	26.6	11.2
	2									38	17					
	3									29	23					
	4									34						
	5									42						
	Ave		11	17	21	16	38	24	49	32.2	18.7	32				
Yearling	1		0	4	6	1	5	5	8	1	5	2		62	3.9	2.3
	2									6	3					
	3									1	4					
	4									5						
	5									6						
	Ave		0	4	6	1	5	5	8	3.8	4	2				
Fawn	1		2	1	6	1	1	1	4	0	1	4		35	2.2	2.2
	2									7	4					
	3									0	1					
	4									0						
	5									2						
	Ave		2	1	6	1	1	1	4	1.8	2	4				
Unclassed	1		11	13	23	13	15	19	20	20	19	12		286	17.9	4.6
Deer	2									17	17					
	3									24	14					
	4									24						

	5								25							
	Ave	11	13	23	13	15	19	20	22	16.7	12					
Total	1	27	38	69	40	76	69	97	46	48	58		1003	62.7	20.9	
Deer	2								87	52						
	3								71	51						
	4								80							
	5								94							
	Ave	27		38	69		40	76	69		97	75.6	50.3	58		
Miles	1	5	5	5	4	4	5	4	5	4	4		71	4.5	0.5	
	2								4	4						
	3								4.2	5						
	4								5							
	5								4							
Miles	Ave	5	5	5	4	4	5	4	4.4	4.3	4			4.5	0.5	
Km	Ave	8	8	8	6.4	6.4	8	6.4	7.1	6.9	6.4			7.1	0.8	
Deer/mi	Ave	5.4	7.6	13.8	10.0	19.0	13.8	24.3	17.0	11.6	14.5			14.4	5.6	
Deer/km	Ave	3.4	4.8	8.6	6.3	11.9	8.6	15.2	10.6	7.3	9.1			9.0	3.5	

Only seven spotlight counts were made on NavMag this year. Deer numbers on the base showed an almost significant increase (Mann Whitney U-Test, $U' = 61.5$, $n_1 = 12$, $n_2 = 7$, $0.10 > P > 0.05$) in FY95 over FY94 (Table 5). The average number of deer recorded per count rose from 60.2 animals in FY94 to 72.7 animals in FY95. Despite this, the largest single nightly count dropped from 92 deer in FY94 to 85 deer in FY95.

Table 5. Composition of deer seen during spotlight counts on NavMag, FY95.

	----- 1994 ------			---------- 1995 ----------											
Class	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	Mean	SD
Unclassed buck		1	4	2		3			2	2	3		17	2.4	1.0
Spike		3	3	9		4			3	3	4		29	4.1	2.2
2-pt		2	6	4		3			2	3	2		22	3.1	1.5
3-pt		4	3	5		4			1				17	2.4	2.1
4-pt		2	1			2							5	0.7	1.0
Doe		42	33	48		40			36	27	16		242	34.6	10.6
Yearling		8	6	1		5			6	4	3		33	4.7	2.3
Fawn		6	4	5		7			13	3	2		40	5.7	3.6
Unclassed deer		12	18	11		12			16	21	14		104	14.9	3.7
Total	nc	80	78	85	nc	80	nc	nc	79	63	44	nc	509	72.7	14.4
Miles		14	14	15		14			14	14	14		99.0	14.1	
Km		22.5	22.5	24.2		22.5			22.5	22.5	22.5		159.2	22.7	
Deer/mi		5.7	5.6	5.7		5.7			5.6	4.5	3.1		36.0	5.1	1.0
Deer/km		3.6	3.5	3.5		3.6			3.5	2.8	2.0		22.3	3.2	0.6

nc = no count was made.

Other Activities

DAWR began preparation of new deer hunting regulations in FY95. These will attempt to increase the overall harvest and thereby reduce some of the ecological damage caused to native plant communities by large deer populations. Changes under consideration include: 1) extending the season to six months from October through March; 2) allowing up to three deer to be taken per hunter; and 3) allowing females to be taken. A public hearing on the proposed regulations was held on September 27.

Little published information has appeared on the status and ecology of deer on Guam since Wheeler (1979). Therefore, work was started on a new publication to update readers on recent population trends and hunter harvests, general biology, and ecological impacts, as well as needed management actions. Information will be provided on deer populations in Guam, the Commonwealth of the Northern Mariana Islands, and Pohnpei.

RECOMMENDATIONS

Continue spotlight counts at present intensity on AAFB and NavMag and the distribution of hunter questionnaires after each hunting season. Collect biological data from carcasses whenever possible. A study to examine the impacts of deer on native ecosystems is badly needed.

PROGRAM COST

The estimated cost of the project under W-1R-3 is $33,000.

LITERATURE CITED

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Wheeler, M. E. 1979. The biology of the Guam deer. Div. Aquatic Wildl. Resources Tech. Rept. No. 3, Mangilao, Guam. 53 pp.

Report prepared by: Gary J. Wiles and Benedict P. Reyes

APPENDIX 1

The Population Size and Distribution of Wild Asiatic Water Buffalo on Guam

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

The abundance of wild (feral) Asiatic water buffalo (*Bubalus bubalis*) on the U.S. Naval Magazine (NavMag) showed a significant decrease during FY95.

RESULTS

Spotlight counts of Asiatic water buffalo, known locally as carabao, on NavMag were initiated in about 1966 by the Division of Aquatic and Wildlife Resources (DAWR). The size of the base's herd remained fairly constant from 1966-1978, averaging about 0.6-0.8 animals/km traveled during counts (Anderson 1980). Numbers began to increase in 1979 and peaked in 1982, with a mean of 2.6 animals/km (DAWR 1980-1982). Buffalo abundance declined thereafter, falling to a mean of about 1.5-1.7 animals/km during 1986-1988 (DAWR 1983-1988). Counts increased to an average of 2.5 animals/km in 1989 (DAWR 1989), then fell to 1.4-2.1 animals/km for 1990-1993 (DAWR 1990-1993). Numbers rose again in 1994 to 2.7 animals/km (DAWR 1994). Illegal hunting appears to be the major cause of mortality in the population (Conry 1988). High buffalo densities have resulted in localized habitat damage on NavMag (Conry 1988, Biosystems Analysis Inc. 1989).

Methods used were the same as those used for deer counts (Project No. W-1R-3, Subproject No. W-1, Study No. 1, Job No. 1). Only seven spotlight counts were made on NavMag this year. The average number of water buffalo seen per count showed a significant decrease from an all-time high of 2.7 animals/km in FY94 to 1.8 animals/km in FY95 (Mann-Whitney *U*-Test, $U=12.5$, $P < 0.01$) (Table 1).

Table 1. Results of monthly spotlight counts of feral water buffalo at NavMag, FY95.

Month	No. animals observed	Km traveled	Animals/ km	Miles traveled	Animals/ mile
Nov	33	22.5	1.5	14	2.4
Dec	33	22.5	1.5	14	2.4
Jan	74	24.2	3.1	15	4.9
Mar	34	22.5	1.5	14	2.4
Jun	49	22.5	2.2	14	3.5
Jul	28	22.5	1.2	14	2.0
Aug	38	22.5	1.7	14	2.7
Total	289	159.2	-	99.0	-
Ave	41.3	22.7	1.8	14.1	2.9
SD	15.85		0.64		1.00

A mean of 41.3 animals was seen per count this year. The largest number of water buffalo recorded on a monthly count fell from 99 animals in FY94 to 74 animals in FY95. No

additional work to assess population parameters of the NavMag herd was done during the year because of manpower limitations.

PROJECT COSTS: The cost of this project under W-1R-3 was $33,000.

LITERATURE CITED

Anderson, R.D. 1980. Population size and distribution of wild carabao on Guam. Job Progress Report. Federal Aid to Fish and Wildlife Restoration, Guam. Guam Dept. Agric., Mangilao, Guam.

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Report prepared by: Gary J. Wiles

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: W-1R-3
SUB-PROJECT NO.: W-1
STUDY NO.: 2
JOB NO.: 1

JOB TITLE: Population Size and Distribution of Wild Pigs on Guam (1460, 1430)

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

Official logs with harvest statistics for wild pigs were examined for Andersen Air Base (AAFB) and revealed a total of 4,030 hunter sorties, a harvest of 294 pigs, and a harvest rate of one pig per 5.4 hunter days. On the Naval Computer and Telecommunications Area Master Station (NCTAMS), there were 1,935 hunter sorties, a take of 80 pigs, and a harvest rate of one pig per 10.6 hunter days. Harvest data were not available for other parts of Guam. Based on hunter questionnaire responses for the entire island, an estimated total of 443 hunters took 998 pigs during 5,994 hunter days for the year. Twenty-six pig depredation permits were issued to farmers in FY95.

BACKGROUND

Wild pigs (*Sus scrofa*) are Guam's most important game species in terms of total numbers of animals harvested. This species has been studied by the Division of Aquatic and Wildlife Resources (DAWR) since 1967 (Conry 1988, DAWR 1967-1994). The island's wild pig population is descended from domestic *S. scrofa* introduced by the Spanish from the Philippines between 1672 and 1685. Wild pigs are found island-wide, but appear to be most numerous in the limestone forests of the north and the ravine forests of southern Guam. Pigs occur at high enough densities in many forested areas that rooting and wallowing damage is common and can be quite severe locally. Depredation on agricultural crops is also a problem, especially in southern Guam during the dry season. Controlling the effects of pig damage is recognized as an important measure to protect native forest and agricultural resources. Recreational harvest is the primary tool used to control pig numbers and current hunting regulations allow for a year-round season with bag limits of 2 pigs per day and 40 per year. There is a need to consider more liberal regulations to control pig populations island-wide and in localized areas.

OBJECTIVES

To monitor trends in pig population size and hunter participation and harvest.

PROCEDURES

1. Monitor hunter participation and harvest during the legal hunting season.

2. Record pig sightings during deer spotlight counts, and observations of pigs or pig sign during other fieldwork.

RESULTS

Pig hunting data generated from hunter questionaire responses are presented in Tables 1 and 2 for FY94 and FY95. In FY94, an estimated 479 hunters spent 10,133 days to harvest a total of 2,631 wild pigs, with an estimated 3.8 hunter-days (one hunter = 8 hours) expended per pig taken. In FY95, an estimated 324 hunters spent 5,994 days to harvest a total of 998 pigs, with an estimated 6.0 hunter-days expended per animal taken. Data for both years are based on fairly small samples of returned questionaires. In both years, questionaires were distributed by hunting license vendors at the time when hunters purchased their licenses. In previous years, the DAWR had mailed questionaires directly to hunters at the close of each fiscal year. This change in procedure may account for the lowered rates of questionaire returns. The estimated harvest of 2,681 pigs in FY94 seems unrealistically high, and is probably a result of the small number of hunters that returned their questionaires for that year.

Table 1. Summary of island-wide pig hunting statistics for FY94 derived from hunter questionnaires distributed with game licenses during FY95.

a.	Total license sales for all game species	750
b.	Number of questionnaires distributed	-*
c.	Number of questionnaires returned	47
d.	Percent queried license buyers that hunted any species	-
e.	Number of reporting license buyers that hunted any species	32
f.	Percent of license buyers that hunted	68.1%
g.	Estimated total number of legal hunters	511
h.	Number of reporting hunters that hunted pigs during the regular season	30
i.	Percent of reporting hunters that hunted pigs during the regular season	93.8%
j.	Number of successful pig hunters	23
k.	Hunter success	76.7%
l.	Number of pigs taken by the 23 successful pig hunters	169
m.	Average number of pigs taken per successful hunter	7.3
n.	Hunter-days expended by reporting pig hunters	635
o.	Average number of days spent per reporting pig hunter	21.2
p.	Estimated total number of legal pig hunters	479
q.	Estimated total number of successful pig hunters	367
r.	Estimated total pig take	2,681
s.	Estimated total number of days spent hunting pigs	10,133
t.	Number of days spent hunting per pig taken	3.8

*actual number of questionaires distributed by vendors is unknown.

Table 2. Summary of island-wide pig hunting statistics for FY95 derived from hunter questionnaires distibuted with game licenses during FY95.

a.	Total license sales for all game species	822
b.	Number of questionnaires distributed	-*
c.	Number of questionnaires returned	61
d.	Percent queried license buyers that hunted any species	-
e.	Number of reporting license buyers that hunted any species	37
f.	Percent of license buyers that hunted	60.7%
g.	Estimated total number of legal hunters	499
h.	Number of reporting hunters that hunted pigs during the regular season	24
i.	Percent of reporting hunters that hunted pigs during the regular season	64.9%
j.	Number of successful pig hunters	20
k.	Hunter success	83.3%
l.	Number of pigs taken by the 20 successful pig hunters	74
m.	Average number of pigs taken per successful hunter	3.7
n.	Hunter-days expended by reporting pig hunters	443

o.	Average number of days spent per reporting pig hunter	18.5
p.	Estimated total number of legal pig hunters	324
q.	Estimated total number of successful pig hunters	270
r.	Estimated total pig take	998
s.	Estimated total number of days spent hunting pigs	5,994
t.	Number of days spent hunting per pig taken	6.0

*actual number of questionaires distributed by vendors is unknown.

Records of hunting activity and harvest were kept by officials AAFB and NCTAMS throughout the year (Table 3). According to hunter logs from AAFB, 1,013 hunter-days (2,545 sorties; gun hunting only) were expended at Northwest Field (NWF) resulting in the harvest of 144 pigs. The Conventional Weapons Storage Area (CWSA) recorded 145 hunter-days (298 sorties; bow hunting only) with 45 pigs taken. Hunting areas on the rest of the base (Tarague basin, landfill area, and Andersen South) recorded 422.2 hunter-days (1,187 sorties; primarily bow hunting) and had 105 pigs harvested. At NCTAMS, 848.1 hunter-days (1,935 sorties) were expended, with 80 pigs killed. These records indicate a total kill of 374 pigs on military lands.

Table 3. Hunter effort and wild pigs taken on Naval Computer and Telecommunications Area Master Station (NCTAMS), Northwest Field, and Andersen Air Force Base during FY95, based on official hunter logs.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Andersen Air Force Base													
Northwest Field (gun hunting only)													
No. hunter sorties	449	758	329	149	58	69	90	13	14	65	85	466	2545
No. hunter days (8 hr)	220.9	260	122.5	47.8	18.3	22.8	27.8	4.5	4.1	24.9	32.9	226.6	1013.1
Pigs taken	30	25	15	16	11	16	10	2	1	5	13	24	144
Days effort/take	7.4	10.4	8.2	3.0	1.7	1.4	2.8	2.3	4.1	5.0	2.5	9.4	7.0
CWSA (bow hunting only)													
No. hunter sorties	127	137	---------- area closed to all hunting ----------									34	298
No. hunter days (8 hr)	61.5	68.9										14.6	145
Pigs taken	22	16										7	45
Days effort/take	2.8	4.3										2.1	3.2
Other Areas of the Main Base (primarily bow hunting)													
No. hunter sorties	225	161	172	99	75	80	83	111	101	27	35	18	1187
No. hunter days (8 hr)	94	57.6	60.6	29.8	21.9	29.1	27.1	36.8	35.1	10.4	11.9	7.9	422.2
Pigs taken	14	7	24	22	16	12	1	0	0	5	3	1	105
Days effort/take	14.2	8.2	2.5	1.4	1.4	2.4	2.7	-	-	2.1	4.0	7.9	4.0
NCTAMS (gun and bow hunting)													
No. hunter sorties	228	287	321	85	83	111	98	113	123	72	72	342	1935
No. hunter days (8 hr)	111.9	121.9	150.5	39.1	30.4	54.4	39.1	45.5	47.6	33.5	32.6	141.6	848.1
Pigs taken	8	9	10	5	6	6	7	8	5	4	2	10	80
Days effort/take	14	13.5	15.1	7.8	5.1	9.1	5.6	5.7	9.5	8.4	16.3	14.2	10.6

Depredation Permits

The DAWR issued 26 pig depredation permits to farmers during FY95. Permits were written for the following villages: Inarajan, 8; Talofofo, 8; Mangilao, 3; Merizo, 3; Barrigada, 1; Dededo, 1; Ordot, 1; and Yigo, 1. Farmers reported damage to the following

types of crops: watermelons, 12 complaints; bananas, 9; taro, 9; canteloupe, 7; cucumbers, 7; eggplant, 5; sweet potatos, 5; string beans, 5; papaya, 4; okra, 3; bittermelon, 2; honeydew, 1; sweet melons, 1; other beans, 1; pepper bushes, 1; yams, 1; bell peppers, 1; coconut seedlings, 1; mango seedlings, 1; betelnut seedlings, 1; and lemons, 1.

The Animal Damage Control unit of the U.S. Department of Agriculture began a pig trapping program on the U.S. Naval Magazine (NavMag) this year. A total of 12 pigs were removed from the base between January and September.

Other Activities

The DAWR began preparation of new hunting regulations in FY95. These will attempt to increase the overall pig harvest and thereby reduce some of the ecological damage caused to native plant communities by large pig populations. Changes under consideration include the removal of daily and annual bag limits for wild pigs. A public hearing on the proposed regulations was held on September 27.

RECOMMENDATIONS

Continue to monitor the annual pig harvest and hunter participation. Coordinate accurate record keeping and reporting of hunter effort and harvest at military bases.

PROGRAM COST: The estimated cost of the wild pig project under W-1R-3 is $18,000.

LITERATURE CITED

Conry, P. J. 1988. Ecology of the wild (feral) pig (*Sus scrofa*) on Guam. Tech. Rept. No. 7. Div. Aquatic and Wildl. Res., Dep. Agric., Mangilao. 60 pp.

Division of Aquatic and Wildlife Resources. 1967-1994. Job Progress Report - Federal Aid to Fish and Wildlife Restoration. Guam Dept. of Agriculture, Mangilao, Guam.

Report prepared by: Gary J. Wiles and Benedict P. Reyes

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: W-1R-3
SUB-PROJECT NO.: W-2
STUDY NO.: 1
JOB NO.: 2

JOB TITLE: Population Numbers and Distribution of Philippine Turtle-Doves (1460, 1430)

PERIOD COVERED: October 1, 1994 to September 30, 1995.

SUMMARY

This year's spring bird survey showed a significant change in the relative abundance of Philippine turtle-doves (*Streptopelia bitorquata*) from FY94. The Conventional Weapons Storage Area (CWSA) had a significant decrease in numbers of birds/station ($p < 0.001$). Northwest Field (NWF) decreased slightly ($p > 0.05$).

BACKGROUND

The Philippine turtle-dove was introduced to Guam by the Spanish during their early colonization of the region, circa 1771 (Baker 1951) and has been regulated as a game bird since at least 1903 (Conry 1987). Up through the early 1960s, the turtle-dove was very common and found in large numbers in both northern and southern Guam. By the late 1960s, dove populations in southern and central Guam began to decline and have since stabilized at low levels. Populations in northern Guam declined in the late 1970s and early 1980s. Turtle-doves are now found in appreciable numbers in prime dove habitat on NWF, CWSA and elsewhere on Andersen Air Force Base (AAFB) and at moderate numbers in selected areas of central and southern Guam. A large population still remains on snake-free Cocos Island. Predation by the brown tree snake (*Boiga irregularis*) is the major cause of nest loss (Conry 1988) and this introduced pest is thought to be responsible for the population decline. Because of the decline in numbers and the extremely poor nesting success, the Department of Agriculture officially closed the turtle-dove hunting season in March 1987. The season will be reopened if nesting success improves and numbers recover to a level that can support recreational hunting.

OBJECTIVES

1. To determine present population levels and distribution, and monitor population trends.

2. To investigate nesting success and causes of nest failures.

PROCEDURES

1. Call-count and roadside-count surveys were conducted at NWF and CWSA. Both surveys were conducted once or twice monthly in the early morning hours. The call-count survey consisted of counting the number of doves seen or heard during a 5-minute period at 10 stations in NWF plus the number of doves seen enroute between stations. The roadside-count survey at CWSA involved counting the number of turtle-doves seen while driving at 25 km per hour along an established 32 km route. The Philippine turtle-dove is also included in a once or twice monthly roadside-count of all

birds conducted by Division of Aquatic and Wildlife Resources conservation officers in 3 areas of northern Guam. The results of these surveys are reported in Job W-1-3.

2. Philippine turtle-doves were additionally surveyed during spring bird counts conducted on 23 routes throughout the island in June. These surveys consisted of 5-minute station counts at up to 10 stations per route with the number of birds seen or heard recorded at each station. Results are summarized as the average number of birds observed per station.

RESULTS

Population Surveys

Call count surveys and roadside counts were continued at NWF and CWSA on AAFB (Table 1). Surveys on NWF decreased slightly over the previous year, but not significantly (Mann Whitney *U*-Test, $n_1 = 10$, $n_2 = 10$, $U = 66$, $p > 0.05$, Sokal and Rohlf 1981). The average count decreased 17% from 9.0 birds/survey in FY94 to 7.5 birds/survey in FY95.

Table 1. The number of Philippine turtle-doves recorded during monthly surveys at NWF and CWSA on Andersen Air Force Base in FY95.

Month	NWF	CWSA
Oct	11	12
Nov	6	12
Dec	4	10
Jan	9	8
Feb	2	8
Mar	4	8
Apr	no data	6
May	5	5
Jun	10	no data
Jul	6	11
Aug	18	10
Sep	no data	no data
Mean	7.5	9.0
SD	4.5	2.2

Roadside counts in the CWSA decreased significantly over previous the year's counts (Mann Whitney *U*-Test, $n_1 = 11$, $n_2 = 10$, $U = 96$, $p < 0.001$). The average count per survey decreased 32% from 13.3 birds/count in FY94 to 9.0 birds/count in FY95.

Spring Bird Surveys

Turtle-doves were recorded on 19 of 23 (83%) spring bird surveys conducted in FY95 (Table 2). Snake-free Cocos Island still has by far the highest count results, with an average of 2.3 birds observed per station. Orote Point and Cocos Island were the only routes which had an average of ≥ 1.0 birds/station. Of the 23 routes surveyed, 14 (61%) recorded decreases, 2 (9%) recorded increases, and 4 (17%) recorded no change in the number of birds observed. There was a significant change from last year's survey (Wilcoxon Signed-rank Test, $T_S = 45.5$, $Z = -1.75$, $p < 0.05$).

Table 2. Numbers of Philippine turtle-doves observed per count and average number of birds per station as detected in spring bird surveys at various locations on Guam during May 1995. Values in the trend column are the difference between the average station count between years.

Survey Location	No. Stations	No. Doves Observed	1995 Ave./ Station	1994 Ave./ Station	Trend in Ave. 95-94
Tarague	10	4	0.4	0.4	0.0
CWSA	10	7	0.7	0.9	-0.2
NWF	10	3	0.3	0.6	-0.3
NCTAMS	10	2	0.2	0.8	-0.6
Capitol Improvement Road	10	2	0.2	0.5	-0.3
Mt. Santa Rosa	10	4	0.4	1.0	-0.6
Y-Sengsong Road	10	2	0.2	0.3	-0.1
Two Lover's Point	10	3	0.3	0.1	0.2
Andersen South	10	2	0.2	0.7	-0.4
Navy Golf Course Barrigada	10	4	0.4	1.6	-1.2
Barrigada Hill	10	3	0.3	0.6	-0.3
Toto Pipeline	8	0	0.0	0.9	-0.9
Nimitz Hill	10	2	0.2	0.0	0.2
Reserve Craft Beach Road	4	1	0.3	0.3	0.0
Orote Point	6	6	1.0	0.3	-0.2
Pulantat	10	0	0.0	0.9	-0.9
Cross Island Road	10	6	0.6	0.3	0.3
Naval Magazine	10	6	0.6	0.6	0.0
Umatac	10	0	0.0	0.0	0.0
Dandan	10	1	0.1	0.2	-0.1
Ija	8	5	0.6	0.6	0.0
Merizo	8	0	0.0	0.4	-0.4
Cocos Island	10	23	2.3	1.4	0.9

RECOMMENDATIONS

1. Continue call count and roadside count surveys in northern Guam to monitor distribution, relative abundance and population trends of the Philippine turtle-dove.

2. Keep the turtle-dove hunting season closed until nesting success improves and the population recovers.

PROGRAM COST

The estimated cost of the Philippine turtle-dove project under W-1 R-3 is $15, 000.

LITERATURE CITED

Baker, R.H. 1951. The avifauna of Micronesia, its origin, evolution, and distribution. University of Kansas Pub. 3:1-359.

Conry, P.J. 1987. Ecology of the Philippine turtle-dove on Guam. Tech. Rept. No. 6. Div. Aquatic and Wildl. Res., Dept. Ag., Mangilao.

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Sokal, R.R. and F.J. Rohlf. 1981. Biometry. W. H. Freeman and Co. 859 pp.

Report prepared by: Celestino F. Aguon

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: W-1 R-3
SUB-PROJECT NO.: W-2
STUDY NO.: 2
JOB NO.: 2

JOB TITLE: Population Size and Distribution of Black Francolin on Guam (1460, 1430)

PERIOD COVERED: October 1, 1994 to September 30, 1995.

SUMMARY

Black francolin *(Francolinus francolinus)* occurred on 14 of the 23 spring bird survey routes conducted throughout Guam. Nine survey routes showed decreases in bird numbers, 6 routes had increases of 1 or more birds, and 8 routes had no change in the numbers per count. This pattern of change was statistically significant ($p < 0.01$) compared to last year's counts. This species appears able to sustain the current levels of recreational hunting.

BACKGROUND

In 1961, 171 black francolin were introduced to southern Guam as part of the Foreign Game Bird Introduction Program of the U.S. Fish and Wildlife Service. Surveys conducted in 1980 indicated the population was adequately established in most parts of southern Guam to open a hunting season. Regulations were promulgated to open a 1-month season in December 1981 with a 4-bird daily limit and a 20-bird season limit. Francolin populations continued to increase from 1980-1982, but hunting pressure remained low, probably because of the unfamiliarity of the hunting public with the sporting qualities of the bird. With the bird population increasing and little hunting pressure, the francolin season and bag limits were further liberalized in FY83 to a 2-month split season, one month in January and one month in July, and the bag limit was increased to 5 birds per day with no season limit. Revisions to the francolin season were again made in FY90, extending the season from January 1 to February 28 and from July 1 to August 31. Francolin hunting has increased in popularity and Guam hunters are successfully harvesting birds during the open seasons. Regulations implemented in FY83 remain in effect with hunter participation and adherence to game laws monitored by spot checks by Division of Aquatic and Wildlife Resources biologists and conservation officers.

OBJECTIVES

To determine current relative abundance and current distribution of black francolin on Guam and monitor population trends and hunter harvest.

PROCEDURES

1. Conduct annual island-wide spring bird surveys (station counts) to monitor distribution and status of francolin throughout the island.

2. Monitor hunter harvest via an annual harvest questionnaire. Collect information on hunter participation, effort, harvest, and areas hunted.

RESULTS

Francolin Hunting Statistics

During the FY94 francolin hunting season, an estimated 128 francolin hunters spent 784 hunter days harvesting 704 birds (Table 1). License sales increased 9% during FY95, with 822 sold during the year compared to the 750 licenses sold last fiscal year (Tables 1, 2). Francolin hunting decreased during FY95, with an estimated 67 hunters spending 456 hunter days harvesting 737 birds (Table 2). Because hunter response rates to questionnaires were low in both years (6% in FY94 and 7% in FY95), the number of birds harvested is probably overestimated. Methods of insuring that responses to questionnaires are submitted should be pursued.

Table 1. Summary of island-wide black francolin hunting statistics for FY94 derived from hunter questionnaires distributed with game licenses during FY95.

CATEGORY	Jan-Feb	Jul-Aug	Total
a. Total license sales for year			750
b. Number of hunter questionnaires returned			47
c. Number of respondents that hunted any species			32
d. Percent of license buyers that hunted			68.1
e. Estimated total number of legal hunters			511
f. Number of reporting hunters that hunted BLFR	5	3	8
g. Percent of reporting hunters that hunted BLFR (%)	16	9	25
h. Number of successful hunters	5	2	7
i. Hunter success (%)	100	67	88
j. Number of BLFR taken by reporting hunters	34	15	49
k. Average number of BLFR taken per hunter	6.8	5.0	6.1
l. Average no. of BLFR taken per successful hunter	6.8	7.5	7.0
m. Reported number of days spent hunting	29	15	44
n. Average no. of days spent hunting per BLFR hunter	5.8	5.0	5.5
o. Estimated total number of legal BLFR hunters	80	48	128
p. Estimated total legal BLFR harvest	544	240	784
q. Estimated total number of days spent hunt	464	240	704
r. Number of days spent hunting per BLFR taken	0.85	1.00	0.90
s. Number of BLFR taken per day hunting	1.17	1.00	1.11
t. Number of 5-bird daily limits	4	1	5

Table 2. Summary of island-wide black francolin hunting statistics for FY95 derived from hunter questionnaires distributed with game licenses during FY95.

CATEGORY	Jan-Feb	Jul-Aug	Total
a. Total license sales for year			822
b. Number of hunter questionnaires returned			61
c. Number of respondents that hunted any species			37
d. Percent of license buyers that hunted			61
e. Estimated total number of legal hunters			499
f. Number of reporting hunters that hunted BLFR	3	2	5
g. Percent of reporting hunters that hunted BLFR (%)	8	5	14
h. Number of successful hunters	3	1	4
i. Hunter success (%)	100	50	80
j. Number of BLFR taken by reporting hunters	35	20	55
k. Average number of BLFR taken per hunter	11.7	10.0	11.0
l. Average no. of BLFR taken per successful hunter	11.7	20.0	13.8

m. Reported number of days spent hunting	21	13	34
n. Average no. of days spent hunting per BLFR hunter	7.0	6.5	6.8
o. Estimated total number of legal BLFR hunters	40	27	67
p. Estimated total legal BLFR harvest	467	270	737
q. Estimated total number of days spent hunt	280	176	456
r. Number of days spent hunting per BLFR taken	0.60	0.65	0.62
s. Number of BLFR taken per day hunting	1.67	1.53	1.62
t. Number of 5-bird daily limits	2	0	2

Spring Bird Surveys

Black francolin populations remain well established and stable throughout southern Guam and in shrub-grass habitats in central and northern Guam. Francolin were detected on 14 of 23 spring bird surveys made during May 1995 (Table 3).

Table 3. Numbers of black francolin observed per count and average number of birds observed per station as detected in spring game bird surveys at various locations on Guam during May 1995. Values in the trend column are the difference between the average station count between years.

Survey Location	No. Stations	No. Birds Observed	1995 Ave./ Station	1994 Ave./ Station	Trend in Average '95-'94
NORTH SURVEYS					
Tarague	10	0	0.00	0.00	0.00
CWSA	10	0	0.00	0.00	0.00
NWF	10	0	0.00	0.00	0.00
NCTAMS	10	4	0.40	1.10	-0.70
Capitol Improvement Road	10	0	0.00	0.00	0.00
Mt. Santa Rosa	10	0	0.00	0.00	0.00
Y Sengsong Road	10	0	0.00	0.00	0.00
Two Lovers Point	10	9	0.90	2.20	-1.30
Andersen South	10	5	0.50	0.50	0.00
Navy Golf Course	10	11	1.10	4.10	-3.00
Barrigada Hill	10	20	2.00	2.70	-0.70
Toto Pipeline	8	0	0.00	0.30	-0.30
SOUTH SURVEYS					
Nimitz Hill	10	36	3.60	5.20	-1.60
Reserve Craft Beach Road	4	6	1.50	0.25	1.25
Orote Point	6	0	0.00	0.33	-0.33
Pulantat	10	29	2.90	4.60	-1.70
Cross Island Road	10	34	3.40	2.10	1.30
Naval Magazine	10	47	4.70	4.90	-0.20
Umatac	10	43	4.3	3.90	0.40
Dandan	10	46	4.60	3.60	1.00
Ija	8	58	7.25	4.50	2.75
Merizo	4	16	4.00	6.62	2.62
Cocos Island	10	0	0.00	0.00	0.00

They were found on 9 of 11 surveys south of Route 4 and on 5 of 12 routes in northern Guam. The Ija survey route had the highest station count results this year, with an average

of 7.25 birds/station. Ija also recorded the highest relative increase in birds of 2.75 birds/station. The average number of birds detected per station increased on 6 survey routes and decreased on 9 routes between 1994 and 1995 (DAWR 1994). Five of the six routes that recorded increases were southern routes. There was a statistically significant (Wilcoxon Signed-rank Test, $T_S = 39.5$, $Z = -1.165$, $p < 0.01$) pattern of change.

Although francolin were not detected on the Northwest Field route in May, a male francolin was observed during crow surveys in the area during July 1995. This bird was seen at the southwest end of the south runway in a grassy field. No other birds were seen in the area.

RECOMMENDATIONS

1. Continue to monitor francolin population status, distribution, and hunter harvest.

2. Increase the response rate of annual hunter questionnaire.

PROGRAM COST

The estimated cost of the Black francolin project under W-1 R-3 is $14,000.

LITERATURE CITED

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Report prepared by Celestino F. Aguon

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: W-1R-3
SUBPROJECT NO: W-4
STUDY NO.: 1
JOB NO.: 1

JOB TITLE: Survey and Inventory of Non-Game Birds (1460)

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

Roadside counts for native forest birds, cave censuses for island swiftlets (*Aerodramus vanikorensis*), and surveys for Mariana common moorhens (*Gallinula chloropus guami*) at Fena Reservoir continue to document the population trends of Guam's birds. Roadside counts in northern Guam recorded seven species of resident and migrant bird species, but no native forest birds. An average of 15.3 moorhens was recorded per count at Fena Reservoir, with a high of 28 birds and low of five birds. Censuses of swiftlets at Mahlac Cave ranged from 441-495 birds during the year. Only five Mariana crows (*Corvus kubaryi*) were recorded in the annual crow survey, but at least 19 other known birds went undetected. The total crow population estimate for the island is about 24 birds, which represents a significant loss of about 16 birds during the last year. Monthly censuses for Micronesian starlings (*Aplonis opaca*) at Andersen Air Force Base (AAFB) were started this year and averaged 14.4 birds per count.

BACKGROUND

Predation by brown tree snakes (*Boiga irregularis*) is the major factor in the decline of most of Guam's native bird species during the last few decades (Savidge 1987, Conry 1988, Engbring and Fritts 1988). Census data from a variety of sources have documented the extirpations of eight species, while four others have undergone severe population decreases, both in terms of overall numbers and geographic range (Division of Aquatic and Wildlife Resources [DAWR] 1963-1994, Engbring and Ramsey 1984, Wiles et al. 1995).

Common moorhens continue to be scattered throughout the southern and central parts of Guam, with recent population estimates placed at 100-125 birds (Stinson et al. 1991). Island swiftlets occur primarily in one large colony of 400-465 birds on Naval Magazine (NavMag). Three much smaller colonies are also known and occur on NavMag (55-70 birds), in the Lumuna district of Yigo (unknown number), and in the vicinity of the Geus River Valley in Merizo (unknown size) (DAWR 1987-1994, Wiles et al. 1995). Mariana crows are now restricted to AAFB and adjacent areas (DAWR 1992-1994, Wiles et al. 1995). Their population fell to an estimated 40-50 birds in the early 1990s. A small population of Micronesian starlings also persists on the island, with most birds remaining on AAFB and Yigo, while smaller numbers occur on Cocos Island and coastal areas of southern Guam (DAWR 1991-1994, Wiles et al. 1995). Recovery plans have been written for each of these species except the starling (Beck and Savidge 1990, U.S. Fish and Wildlife Service 1991a, 1991b). In addition, Guam continues to retain small to moderate numbers of several other resident bird species, as well as migratory shorebirds, seabirds, and waterfowl.

OBJECTIVES

To continue status surveys and natural history studies as called for in the recovery plans for Guam's endangered native birds (Beck and Savidge 1990, U.S. Fish and Wildlife Service 1991a, 1991b).

PROCEDURES

1. Roadside counts were conducted at bi-weekly intervals on three routes (North, North-Central, and Northwest Field (NWF); see previous annual reports for locations of routes) in northern Guam by DAWR conservation officers. These routes were driven at approximately 15-25 kph beginning at sunrise. Numbers and species of all birds seen or heard were recorded, irrespective of the distance from the observer.

2. Several surveys for common moorhens were conducted at Fena Reservoir on NavMag. Two or three observers paddled a canoe to the southern end of the reservoir before sunrise. The count began shortly after sunrise with the canoe paddled northward along both shorelines of the reservoir. Locations of moorhens seen and heard were recorded.

3. Monthly visits to Mahlac Cave on NavMag were made to monitor the island swiftlet colony. When counts were conducted, observers sat at both entrances of the cave for a period of 1-2 hours before dark and recorded the numbers of birds flying in and out. The total number of birds inhabiting the cave was determined by subtracting the number of departures from the number of arrivals and by adding the number of birds estimated to be in the cave at the start of the count. During all visits, observers entered the cave for about 1 hr (prior to any counts) to record numbers of nestlings and listen for their calls. In order to avoid disturbing nesting birds, nests were viewed from a slightly elevated position off to the side of the cave rather than by using a mirror up to look inside the nests. The cave floor was searched and cleaned each month of eggshell fragments and whole eggs that had fallen from nests overhead and of snake tracks found in the guano.

4. Recorded-call playback surveys for Mariana crows were conducted in northern Guam. At each station, tape-recorded calls were played for 2.5 minutes. This was followed by a 2-minute silent period during which the observer listened for crows. The numbers, distance, and plumage condition of the crows observed were recorded.

RESULTS

Roadside counts continue to document the status of birds in northern Guam. Tables 1, 2, and 3 present monthly count data for FY95. Table 4 summarizes the data for all three routes during the year. Six species were observed on the North count (Table 1).

Five species were observed on the NWF route (Table 2). All showed fewer detections than last year, except for the Eurasian tree sparrow which was not observed last season. This route failed to record any Mariana crows this year, although one was observed during FY94. Though black francolins were not observed along this route this year, a single bird was observed in the north runway (southwest end) area on several occasions.

Six species were noted on the North-Central route (Table 3). All species observed recorded increases except the Philippine turtle-dove, which showed a slight decrease. Noteworthy is the two-fold increase in the number of sparrows observed from 16.0

birds/count in FY94 to 33.5 birds/count in FY95. The mean number of yellow bitterns observed increased 187% over last year's counts (Table 4).

Table 1. The average number of birds observed each month on the North roadside counts in FY95. Ave = the average number of birds for all counts combined.

Species	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	Ave
Yellow bittern	0	0	0	0	0	0	0	0	0	0.5	0	0.5	2	0.1
Black francolin	0.5	0	0	1	0.5	0	0	0	0	1.5	0	0	6	0.3
P. golden-plover	0	13.5	13.5	17	31.5	13	8	0	0	0	0	22	212	9.6
Ph. turtle-dove	2.5	1.5	1	1	3	1	0	0	0	0	3	10	45	2.0
Black drongo	7.5	3	1	1	1.5	0.5	7	0	4	2	3.5	7	64	2.9
E. tree sparrow	22	8.5	0	2	22.5	2	3	3	30	26.5	18	14.5	270	12.3
No. counts	2	2	2	2	2	2	1	2	1	2	2	2	22	
Total km	81.3	78.1	76.9	76.9	78.9	76.4	40.9	80.3	38.6	75.6	77.3	77.9	859.1	

Table 2. The average number of birds observed each month on the Northwest Field roadside counts in FY95. Ave = the average number of birds for all counts combined.

Species	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	Ave
P. golden-plover	8	13	11	23	13.5	15	20	1	0	0	0	9.5	177	8.9
White tern	0	0	0	0	0	0	0	0	0	0	0.5	0	1	0.1
Ph. turtle-dove	3	0.5	1	2	0	6	3	4	1	3	5	7.5	60	3.0
Black drongo	0	2	1.5	5	0	3	3	1.5	3	1	0	3.5	35	1.8
E. tree sparrow	0	3	0	0	0	0	0	0	0	0	0	1.5	9	0.5
No. counts	1	2	2	2	2	2	1	2	1	1	2	2	20	
Total km	13.2	36.5	33.2	34.3	36.2	35.7	18.5	34.6	16.4	20.1	38.6	26.4	343.8	

Table 3. The average number of birds observed each month on the North-Central roadside counts in FY95. Ave = the average number of birds for all counts combined.

Species	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	Ave
Yellow bittern	0	3	7.5	3.5	0	1	1	4	0	2	0.5	0	43	2.2
Black francolin	0	0	0	5	0	1.7	8.8	6.5	2	15	3	4.5	68	3.4
P. golden-plover	0	657.5	0	0	0	4.3	49	0	0	0	1	7	1393	69.7
Ph. turtle-dove	0	9	5	3.5	5	2.3	2	4.5	6	0	4.5	6	85	4.3
Black drongo	6	5	3.5	2.5	1	0.7	3	2.5	4	7	2.5	2.5	60	3.0
E. tree sparrow	26	15	50	75.5	0	17	26	47	12	95	42.5	0	670	33.5
No. counts	1	2	2	2	1	3	1	2	1	1	2	2	20	
Tot km	20.9	41	40.6	40.2	20.1	57	19.3	40.2	21.1	19.3	43.5	40.6	403.8	

Table 4. Results of North, Northwest Field (NWF), and North-Central (N-C) roadside counts showing the mean number of birds per 100 km of travel and the standard deviation (SD).

Species	North No. per 100 km	SD	NWF No. per 100 km	SD	N-C No./100 km	SD
Yellow bittern	0.26	0.20	0.00	0.00	10.65	2.29
Black francolin	0.77	0.77	0.00	0.00	16.84	26.46
Pacific golden-plover	9.64	27.11	51.49	7.97	188.71	54.70
White tern	0.00	0.00	0.29	0.14	0.00	0.00
Philippine turtle-dove	2.05	5.75	17.45	2.31	21.05	2.60

Black drongo	2.91	8.18	10.18	1.59	14.86	1.89
Eurasian tree sparrow	12.27	34.52	2.62	0.93	165.93	29.41

Common Moorhens

Only three moorhen surveys were conducted at Fena Reservoir during FY95 (Table 5). Surveys averaged 15.3 birds per count (range = 5-28 birds). Nearly all moorhens (47 of 48) were recorded in the southern half of the reservoir. In contrast to FY94, reproductive activity increased at Fena during the year. Nests were found on each survey, with a nest in July having six eggs. Observers saw seven juveniles in April. Beds of the submerged aquatic plant *Hydrilla verticillata* have recovered quite well in the reservoir during the last year or two, and may now be providing improved feeding and nesting substrates for moorhens.

Table 5. Numbers of common moorhens and nests recorded during surveys at the Fena Reservoir in FY95.

Date	Adults	Juveniles	Chicks	Unknown	Total birds	No. of nests	Reservoir water level (ft)
3 Feb	4	0	0	1	5	3	107.5
6 Apr	20	7	0	1	28	1	96
12 July	13	0	0	0	13	2	94

Common moorhens continued to be observed at a number of other locations on the island, including the roadside pond at the Guam prison in Mangilao, an overgrown backyard wetland in Aspengao, Barrigada, the Shell Oil tank farm in Piti, a mostly dried out aquaculture pond at Agfayan Bay, Inarajan, a small wetland near the eastern edge of the Manengon Hills Resort in Yona, and the wetland on Naval Air Station where birds were recorded for the first time last year (DAWR 1994).

Native Doves

No Mariana fruit-doves or white-throated ground-doves were recorded on Guam this year.

Island Swiftlets

Mahlac Cave - Only three censuses of island swiftlets were completed at Mahlac Cave in FY95 (Table 6). Numbers counted ranged from 441-495 birds, which indicates that the colony has probably increased in size during the last year, when counts of 400-465 birds were obtained (DAWR 1994). The September 1995 count of 495 birds was the highest since censuses began in 1987, however, this figure needs to be verified through additional counts. High levels of swiftlet activity at the cave's north entrance continued to necessitate the use of three observers during censuses (see DAWR 1994).

We continued to monitor reproductive activity in the colony this year. Chick production at the 69 nests viewed monthly was highest from January through September (Table 6). This confirms the trend noted in previous years, where most reproduction begins in January and continues until October (DAWR 1987-1994).

Indicators of snake activity in and around the cave were lower than in FY94, but were still judged as high. Snake tracks in the cave's guano deposits were very common on five monthly visits, moderately common on four visits, and uncommon on three visits. Only six shed snake skins were found inside and outside the cave this year. One live snake (SVL = 750 mm, total length = 970 mm, wt = 44 gr, female, stomach empty) was captured

on a rock face outside the cave. Three snake droppings with swiftlet feathers were also found in the cave on the floor beneath the main nesting area.

Table 6. Results of censuses for island swiftlets at Mahlac and Fachi Caves on Naval Magazine during FY95. Evidence of reproductive activities of swiftlets is also presented.

				Reproductive Parameters					
	Net No. of Birds Entering	No. of Birds Estimated in Cave at Start	Total No. of Birds	No. of Whole Eggs Found on	No. of Eggshell Fragments on	No. of Nestlings	No. of Nestlings Seen		
Date	Cave	of Count	Counted	Cave Floor	Cave Floor	Heard	small	med	large
Mahlac Cave									
1 November 1994	462	10	472	2	5	0	0	1	3-4
30 November	-	-	-	0	1	2	0	0	3
28 December	433	8	441	0	3	1-2	1	0	0
30 January 1995	-	-	-	4	15	2-3	4-5	0	4
2 March	-	-	-	1	22	5+	7	17	7
30 March	-	-	-	3	16	2-3	2	3	10-11
28 April	-	-	-	4	26	4+	11	7	4-5
24 May	-	-	-	4	26	5+	3	8	18
27 June	-	-	-	2	15	3-4	4	8	9
31 July	-	-	-	2	5	2-3	3	9	10
1 September	-	-	-	3	10	1-2	2	3	5
26 September	476	19	495	1	5	3-4	4	6	2-4

Fachi Cave - no visits made inside the cave this year

Key: - = no data gathered

The building of mud dauber nests on swiftlet nests was identified as a possible conservation problem in FY93 (DAWR 1993). It was feared that the heavy weight of the mud nests might pull the swiftlet nests off the walls of the cave. During FY95, some dauber nests continued to be constructed on bird nests. However, only one of the 14 swiftlet nests that fell to the cave floor during the year had a mud dauber nest attached to it. The dauber's nest was nearly four times heavier than the swiftlet nest (dry weight = 45.4 gr and 11.7 gr, respectively).

Fachi Cave - No censuses were made at Fachi Cave in FY95. The last count conducted here was in August 1994, when an estimated 55-70 birds were present (DAWR 1994). Heavy rains in August (35.6 cm) and September 1995 (47.3 cm) again caused flooding of the sinkhole outside the cave's east entrance. The water level rose to within 60 cm of the top of the entrance on 1 September and was within 45 cm on 14 September, but likely did not go much higher than this. Birds were able to fly in and out of the cave without much difficulty, as was previously noted under similar conditions in FY94 (DAWR 1994). Water levels were also high at the start of the fiscal year (see DAWR 1994), but receded in the first half of October 1994 after September's heavy rainfall ended.

Other Localities - Several swiftlets were seen foraging over a grassy hillside just south of Bishop Apuron Street in Santa Rita (between NavMag and Cross Island Road) on 23 January. No searches were made during FY95 for the suspected swiftlet colony in the Lumuna region of Yigo.

Swiftlet Counts in the Commonwealth of the Northern Marianas (CNMI) - Gary Wiles traveled to Aguiguan on 21-27 March and 30 May to 7 June to assist the CNMI Division of

Fish and Wildlife with surveys of sheath-tailed bats (*Emballonura semicaudata*). At least 84 caves of various sizes were examined during the trips, and this allowed observations and colony counts of swiftlets to also be made. Swiftlets inhabited seven of the caves, with the following evening counts made: East Black Noddy Cave, 145-190 birds, Guano Cave, 126 birds; Pillar Cave, 55 birds; Cliff Cave, 26 birds (poor count, possibly 50-75 birds were present); Dangkulo Cave, 8 birds; Landing Cave, 2-3 birds; and Stairway Cave, 2 birds.

The study yielded much interesting information about the cave use of swiftlets. Three caves were used by small numbers (<10) of birds, showing that this species is capable of residing in non-colonial situations. Two of the caves (Dangkulo and Landing Caves) were quite large and looked suitable for holding much larger numbers of swiftlets. Both caves were located within 250-600 m of a large colony at Guano Cave, yet the birds apparently chose not to join this colony. Additionally, the survey team found at least 12 other caves on the island that looked large enough for swiftlets to occupy, but did not hold birds. This suggests that night roosting sites do not limit the population.

Another interesting observation was made at New Cave. Thirty-one swiftlets exited the cave from 1730-1845 on 5 June, while 22 birds departed between 1750-1840 on 6 June. No birds were seen to enter the cave on either evening. Although it could not be confirmed because entry into the cave required a rope, it appeared that no swiftlets remained in the cave overnight, as indicated by a lack of swiftlet calls heard from within the cave after the last bird departed. These observations suggest that the cave is used only as a day roost and that birds leave it before dusk to roost in one of the nearby colonies at night. This behavior has not been previously recorded among swiftlets in the Mariana Islands.

Swiftlet foraging activity was most common over limestone forest at the western and northwestern end of the island. Activity was significantly reduced on the eastern half of Aguiguan, suggesting there are no medium-sized or large colonies in this part of the island. Birds typically fed over forests and along forest edges (including exotic forests), but were recorded much less often over open fields, indicating this is poorer habitat for the species. Most of the major inland swiftlet caves have probably now been identified for the island, although a more thorough search of the island's extensive coastal cliffs for caves is needed. Based on survey results, the current swiftlet population on Aguiguan is estimated at about 400-475 birds.

Mariana Crows

Fourteen transects totaling 209 stations were used to survey crows in eight regions of northern Guam during July and early August (Table 7). Transect locations were previously described in DAWR (1990, 1991). A total of five crows were recorded this year, all on Transect 1 in the Conventional Weapons Storage Area (CWSA). This represents a 72% decrease from last year's total of 18 birds, which occurred on seven transects.

The number of crows recorded during the survey is probably much lower than the actual number of birds still surviving in the wild. For example, two groups of crows, each with 3 birds, were not detected on Transect 2 in NWF, but are known to remain in that area (Table 7). Transect 1 in the CWSA is believed to have four additional birds, one of which is a banded rehabilitated female, that were not detected in the survey. At least three known pairs of crows and an unmated individual were not detected in the Pati Point area, and another pair of birds was not recorded on Transect 7 in the Tarague basin. When the number of unrecorded crows is added to the birds found during the survey, an estimate of about 24 birds is obtained and represents a better approximation of the actual size of the Guam population. However, this estimate still suggests a population decrease of 40%,

with at least 16 birds lost during the last year. Detailed field observations revealed that several birds lost paired mates during the year. These include pairs in NWF, the CWSA, and Pati Point.

Table 7. Summary of results from playback of tape-recorded Mariana crow calls conducted in July and early August 1995. Transect locations are described in DAWR (1990, 1991).

Transect	No. of stations	No. of crows	No. of stations with crows	Known no. of crows missed in survey
1	50	5	4	4
2	36	0	0	6
3	12	0	0	0
4	10	0	0	0
5	8	0	0	0
6	11	0	0	0
7	10	0	0	7
8	23	0	0	0
9	8	0	0	0
10	9	0	0	0
11	7	0	0	0
12	8	0	0	0
13	8	0	0	0
14	9	0	0	2
Total	209	5	4	19

Population estimate = 5 + 19 = 24 birds

Electrical barriers were used to protect 14 crow nests from snake predation during the FY95 nesting season, with only one young hatched, which failed to fledge. Four nests (representing two pairs) were abandoned without eggs being laid or incubation observed. Nest building at one nest stopped abruptly after a mate was lost. Another nest was abandoned soon after it was snake-proofed, but the pair went on to successfully lay eggs in subsequent nests. This nest was probably protected after the eggs were preyed on by snakes. Four other pairs laid eight clutches of eggs after their nests were protected. Clutch sizes were as follows: six clutches of one egg, and two clutches of three eggs. Of the 12 eggs laid, 11 (92%) failed to hatch. Eleven of the 12 eggs were candled, with nine eggs (82%) found to be infertile, and two (18%) being fertile. Both fertile eggs came from the pair nesting near Potts Junction. The three eggs from their first clutch failed to hatch. This clutch did contain one fertile egg, which was found to be cracked and contained a dead embryo. The single egg from their second clutch was fertile, and hatched after it was removed from the nest and artificially incubated. This egg also had a crack that was repaired. Disturbances to the nest while incubation was taking place probably caused the parents to damage the eggs. Potential causes of disturbances might include intruder crows, migratory hawks, human disturbances, and aircraft activity. The nestling was hand-reared for two days before being returned to its nest. Unfortunately, it was found dead on the ground beneath the nest when it was 11 days old. It apparently died from the fall. Why it fell from the nest could not be determined.

This year's results strongly suggest that the interventive measures taken resulted in the only successful hatch of the season. However, the continued large number of unsuccessfully hatched eggs (probably due to infertility) requires that further measures, such as the translocation of nestlings and eggs from Rota to Guam, are needed to save the crow

population on Guam. Tarr and Fleischer (1995) reported that the Rota and Guam populations are genetically similar.

Micronesian Starlings

An average of 14.4 starlings were seen per count through the housing and administrative areas of AAFB (Table 8). A map of the route is given in Figure 1.

Table 8. Numbers of birds recorded per month in FY95 on a census route through the AAFB housing and administrative areas. Counts were made at 17 stations along the route; one census was made per month.

Species	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Tot	Ave	SD
Yellow bittern	6	1	2	2	2	6	4			1			24	3.0	2.1
P. golden-plover	21	29	28	24	24	41	74			0			241	30.1	21.1
Brown noddy	0	0	0	0	0	0	3			9			12	1.5	3.2
White tern	0	11	8	6	7	19	17			4			72	9.0	6.4
Ph. turtle-dove	11	15	13	10	8	12	15			24			108	13.5	4.9
Black drongo	36	44	54	22	46	29	52			29			138	39.0	11.7
Micro. starling	24	9	13	14	11	18	8			18			115	14.4	5.4
E. tree sparrow	116	82	77	56	125	96	145			124			821	102.6	29.8

The Air Force did not initiate a proposed nest box program for starlings during the year (see DAWR 1994). It is hoped that this pilot project will proceed in FY96.

Seabirds and Reef-Herons at Cocos Island

No seabird censuses or monitor lizard (*Varanus indicus*) control efforts were made on Cocos Island in FY95. Monitors continue to be commonly seen on the island. No brown tree snake sightings were reported at Cocos island this year.

Notable Species Recorded on Guam during FY95

A number of noteworthy bird sightings were made during the year. Three to four great egrets (*Casmerodius albus*) were seen from 11 December to 3 March at the Agfayan Bay fish ponds in Inarajan and on the reef flat near Balan Point, Merizo. A green-backed heron (*Butorides striatus*) occurred at the same ponds on 18 February. A man-made pond at the Manengon Hills Resort in Yona held a variety of waterfowl during the winter, including a green-winged teal (*Anas crecca*) from 11 December to 5 February, 1-6 common pochards (*Aythya ferina*) from 17 December to 8 March, and an American wigeon (*Anas americana*) from 29 January to 8 March.

The 1994-1995 migration season was exceptionally good for visiting raptors. Numerous sightings of at least one black kite (*Milvus migrans*) were made by the public and DAWR staff from mid-December until at least 12 April, with most records coming from Sinajana, Agana, Asan, Piti, Nimitz Hill, and Naval Station. Several confirmed sightings were also made at Northwest Field in the spring. Several unidentified hawks seen in Yona in May and June may have also been this species. A gray-faced buzzard (*Butastur indicus*) was seen roosting in tree tops near the summit of Nimitz Hill, and was joined while soaring by a second buzzard on a number of mornings, from 16 February to 8 March. A flock of 8-9 large unidentified hawks was observed soaring over NWF on the morning of 28 March and was presumably migrating northward. A large "harrier-like" hawk was observed several times over the winter and spring season flying low over the forests at the CWSA and along the cliffline at Pati Point on AAFB. Sightings of unidentified accipiters, probably Chinese Goshawks (*Accipiter solensis*), occurred on 2 October in Piti and throughout much of the

Figure 1. Map of the route used to count Micronesian starlings and other birds on Andersen Air Force Base. The number "1" represents the first count station on the route and "17" represents the final station.

winter in NWF. A flock of several birds was seen repeatedly on Nimitz Hill in early March.

A greater sand-plover (*Charadrius leschenaultii*) appeared at Dungca's Beach on 2 October. A snowy plover (*C. alexandrinus*) was recorded on the main flightline of AAFB on 31 October, while seven other birds regularly occurred at Dungca's Beach from 26 December to 5 February. Observers noted five oriental pratincoles (*Glareola maldivarum*) among other shorebirds in a large field with an abandoned parking lot on AAFB on 25 May 1995. Pairs of black-winged stilts (*Himantopus himantopus*) were seen at a temporary pool of water at the landfill on AAFB on 6 October and at a water buffalo wallow on NavMag on 26 September. A pair of ruffs (*Philomachus pugnax*) was present at Dungca's Beach on 26 December. A common redshank (*Tringa totanus*) occurred at the Agfayan Bay fish ponds on 6 March.

A black-headed gull (*Larus ridibundus*) was sighted at the Agfayan Bay ponds on 18 February. A pair of little terns (*Sterna albifrons*) and a common tern (*S. hirundo*) were seen at the same ponds on 2 October. Single little terns also appeared at Togcha Beach on 2 October and in Cocos Lagoon near Cocos Island on 22 September. Unusually large mixed flocks of white-winged (*Chlidonias leucopterus*) and whiskered terns (*C. hybridus*) were observed at several locations on Guam (Naval Air Station, AAFB flightline, and a golf course in Mangilao) and Rota in late September and October 1994 (Wiles and Worthington, in press).

A pair of common mynas (*Acridotheres tristis*) was observed several times at the former USO building at the intersection of Routes 1 and 11 in Piti. The birds presumably arrived on island aboard a cargo ship docked at the nearby Commercial Port, or were deliberately released caged birds that had been illegally held. No effort has yet been made to capture the birds.

RECOMMENDATIONS

1. Develop and implement methods for controlling the brown tree snake.

2. Continue bimonthly roadside counts over the three routes in northern Guam.

3. Continue to monitor the population of common moorhens and develop an appropriate habitat improvement and development program.

4. Continue monthly cave censuses and efforts to assess population change and reproductive activity of island swiftlets. Consider snake-proofing Mahlac Cave to protect nesting swiftlets. Conduct further observations on the foraging behavior of swiftlets. Determine whether there is any seasonal variation in the foraging range of the colony. Interview farmers in the Talofofo River valley about the use of pesticides on their farms.

5. Continue to census the Mariana crow in order to estimate population size and distribution. Continue breeding biology studies and attempts to snake-proof nest sites of crows. Explore and initiate methods to improve crow reproductive success.

6. Continue predator control efforts on Cocos Island until complete eradication of monitor lizards and feral cats is attained.

PROGRAM COST: The estimated cost of this project under W-1 R-3 is $128,000.

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Report prepared by: Gary J. Wiles and Celestino F. Aguon

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: W-1R-3
SUB-PROJECT NO.: W-5
STUDY NO.: 1
JOB NO.: 1

JOB TITLE: Natural History, Biology, and Habitat Protection for Mariana Fruit Bats (1410, 1440, 1450)

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

During FY95, Guam's fruit bat population ranged in size from an estimated low of 300-345 animals in October to a high of 440-500 animals in January. The island's only bat colony used one roosting site on Pati Point throughout the year. The U.S. Fish and Wildlife Service (USFWS) conducted a study on the effects of aircraft activity at Andersen Air Force Base (AAFB) on the roosting behavior of bats. One possible illegal hunting incident was reported this year. A ban on fruit bat imports from Palau went into effect on 1 October, resulting in virtually no legal shipments of bats entering Guam in FY95. There is some evidence that an illegal bat trade may have started. The Division of Aquatic and Wildlife Resources (DAWR) participated in three bat surveys in the Commonwealth of the Northern Mariana Islands (CNMI) during the year. Two surveys were conducted for sheath-tailed bats (*Emballonura semicaudata*) and fruit bats on Aguiguan, while a third trip was made to Anatahan to census fruit bats.

BACKGROUND

The Mariana fruit bat (*Pteropus mariannus mariannus*) has been studied by the DAWR since 1962 (DAWR 1964-1994). Considered a delicacy by Chamorro residents, bat abundance declined during the 1960s and 1970s until only a few solitary animals remained (Perez 1972, Wheeler and Aguon 1978, Wiles 1987a). A second species, the little Marianas fruit bat (*P. tokudae*), also occurred on the island, but is now extinct (Wiles 1987a). Reasons for the declines were primarily overhunting and some loss of habitat (Wheeler 1979). Both *Pteropus* have been placed on the U.S. and Guam Endangered Species Lists. The island's population of Mariana fruit bats grew to an estimated 850-1,000 animals in the early 1980s, probably from immigration of bats from Rota (Wiles 1987a, Wiles and Glass 1990). However, numbers have gradually declined since 1983 because of continued illegal hunting and predation by brown tree snakes (*Boiga irregularis*) (Wiles 1987a, 1987b, Wiles et al 1995). During FY94, Guam's fruit bat population ranged in size from an estimated high of 550-625 animals to a low of 275-320 animals (DAWR 1994).

OBJECTIVES

To continue status surveys and natural history studies and to provide for continued protection of habitat as recommended in the Mariana Fruit Bat Recovery Plan (Wiles 1990).

PROCEDURES

1. Survey fruit bat distribution and numbers in Guam and the CNMI as initiated in the late 1970s.

    a. Conduct annual surveys of fruit bats along Guam's northern cliffline with periodic surveys made elsewhere on the island. The emphasis of surveys should be to search for solitary bats and additional bat colonies.

    b. Conduct monthly censuses at known bat colonies on Guam.

    c. Assist the CNMI Division of Fish and Wildlife with surveys of fruit bats on other islands as needed.

2. Record information on the behavior and reproduction of fruit bats in colonies.

3. Determine habitat use of fruit bats. Visit abandoned roost colonies and record information about terrain and the size and abundance of vegetation present.

4. Monitor fruit bat imports to Guam from other Pacific islands.

5. Investigate illegal hunting of fruit bats on Guam. Visit abandoned roosting sites of colonies to determine illegal hunting effort. Assist conservation officers with investigations of bat poaching.

RESULTS

Locations of Bat Colonies on Guam

The island's only known fruit bat colony resided at Roost 1 on Pati Point at AAFB throughout FY95 (Tables 1 and 2). This location has been a preferred roosting site for a number of years (DAWR 1987-1994).

Table 1. Approximate dates of use of the roost used by the only known colony of Mariana fruit bats on Guam in FY95.

Roost Number	Roost Location	Approximate periods of use by bats
1	North Pati Point	2 July 1994 - present

Surveys of Fruit Bats on Guam

During FY95, counts at Roost 1 increased from 193 bats in October 1994 to 315 bats in January (Table 2). Numbers remained fairly high through April, then gradually declined to 246 animals by early October 1995. This pattern follows a general trend noticed in recent years of larger counts during the winter months of December-February and reduced counts from May-September (DAWR 1994). Data analyses indicate that numbers on Guam and Rota fluctuate inversely with one another and are highly suggestive of seasonal inter-island movements.

Table 2. Counts of Mariana fruit bats at roosts on Andersen AFB, Guam in FY95.

	Roost Number									
Date	1	14	15	16	17	18	19	20	21	Total
2 Sept 1994	180	-	-	-	-	-	-	-	-	180
13 Oct	193	0	0	0	-	0	0	0	0	193
31 Oct	194	0	0	0	-	0	0	0	0	194
29 Nov	255	0	0	0	-	0	0	0	0	255
5 Jan 1995	302	0	0	0	-	0	0	0	0	302
26 Jan	315	0	0	0	-	0	0	0	0	315
27 Feb	291	-	-	-	-	-	-	-	-	291
16 Mar	296	-	-	-	-	-	-	0	-	296
29 Mar	309	-	-	-	-	-	-	-	-	309
27 Apr	297	-	-	-	-	-	-	-	-	297
25 May	274	-	-	-	-	-	-	-	-	274
26 June	269	0	0	0	-	0	0	0	0	269
1 Aug	262	-	-	-	-	-	-	-	-	262
31 Aug	269	-	-	-	-	-	-	-	-	269
2 Oct	246	0	0	0	-	0	0	0	0	246

- = site was not checked for bats

Estimates of fruit bat numbers at the main colony on Pati Point can be made using the high and low roost counts for the year. Because some individuals were probably hidden by thick foliage during counts, the total number of adults in roosts was likely to be 10-20% higher than the actual number recorded. In addition, based on observations made in August 1994, approximately 52% of the adults in the colonies were harem females (DAWR 1994). About 10% of these animals possessed unweaned young. These figures provide an estimated high of 347-378 adults and 18-20 juveniles, or a total of 365-398 bats during late January, and a low of 212-232 adults and 11-12 juveniles, or a total of 223-244 bats at the start of the fiscal year.

Incidental daytime sightings of single fruit bats or pairs of bats were made during the year at the Conventional Weapons Storage Area on AAFB (6 sightings) and Tarague basin and beach (2 sightings). The staff of the Guam National Wildlife Refuge made almost daily sightings of bats at Ritidian Point. Only two nighttime sightings were reported, with one at Tarague Beach and another in Asmuyao, Mangilao about 700 m southwest of the intersection of Routes 10 and 15. There was also a report of a bat at an unknown time of day along the base of the hills at Tutujan, Agana Heights.

Excluding bats residing in the colony at Pati Point, an estimated 50-75 fruit bats are still believed to live solitarily or in small groups in northern Guam, primarily along the cliffline extending from Bijia Point to Iates Point. An additional 25 animals probably inhabit Naval Magazine and other forested areas in southern and central Guam. Based on these figures, Guam's island-wide population of fruit bats varied from an estimated low of 300-345 animals in October to a high of 440-500 animals in January.

Surveys of Fruit Bats on Other Islands

The DAWR participated in three bat surveys in the CNMI in FY95.

Anatahan - A desire by the Secretary of the CNMI Department of Lands and Natural Resources to hold a legal hunt for Mariana fruit bats on Anatahan was the motive for conducting a census of this island's bat population on 19-27 July. The survey team counted bats using a combination of techniques, including direct colony counts, colony

departure counts, and station counts. Good geographic coverage of the island was obtained, including both of the island's craters. Bats were common in many areas of the island, particularly at lower elevations (< 400 m), but were relatively rare in other parts. An overall minimum population estimate of about 2,000 animals was made. Seven colonies were found, four of which held about 280-430 animals each. Bats were closely associated with remnants of ravine forest. *Pandanus tectorius* was heavily used as a food during the survey. Baby bats were not attached to any of the hundreds of adults seen in flight, indicating an absence of births during the previous 1-2 months. This was perhaps a result of Typhoon Wilda, which struck the island nine months earlier. A final trip report is currently being prepared (A. Marshall, in prep.).

Aguiguan - Incidental data on the fruit bats on this island were gathered during two surveys for sheath-tailed bats from 21-27 March and 30 June-7 June. On both trips, fruit bats were found to be fairly common and well distributed in limestone forest. In March, small colonies containing 15, 5, 5, and 37 bats were discovered and the island's population was estimated at 75-100 animals. In May-June, only a single large colony with about 75-85 bats was found, suggesting a higher population of about 100-125 animals. *Ochrosia mariannensis* was a major food item in the diet of fruit bats on both trips. A more extensive write-up of the survey team's observations will appear in a manuscript for publication.

Aircraft-Fruit Bat Interactions

Observations from previous years suggest that military aircraft noise can occasionally disturb fruit bats roosting in the vicinity of the AAFB airfield and result in the abandonment of roosts (DAWR 1994). Because of this, the USFWS conducted a field study of the effects of flyovers by aircraft on roosting bats in FY95. This was done primarily by comparing ethograms of animals roosting at Roost 1 during normal conditions and during periods of aircraft activity. Results of the study are currently being compiled for a final report (J. Morton, in prep.). One observation of particular interest during the study occurred when a B-1 bomber took off from the northeast end of the airfield and flushed about 60 bats from the roost. All of the bats resettled in the colony within 7 minutes.

Illegal Hunting

Poaching has long been a major cause of mortality of *P. mariannus* in the southern Mariana Islands (Wiles 1987a, Wiles et al. 1989, Stinson et al. 1992). Poaching still occurs commonly on Rota and other islands in the Marianas (D. Worthington, pers. comm.). With the termination of legal bat imports from Palau on 1 October 1994, it was feared that increased poaching activity might occur throughout the archipelago (Wiles 1994). Fortunately, this did not appear to happen on Guam. Only one unverified incident of illegal hunting was reported during the year. A man was heard speaking at a party about killing as many as 18 bats at a kapok tree in Canada, Barrigada during the kapok flowering season in January. Although the number of animals may have been an exaggeration, information accompanying the report was generally accurate and suggestive that at least some bats could have been killed.

In the CNMI, there are indications that illegal harvesting of fruit bats has perhaps increased since October. Several reports were obtained of bats being regularly killed on the islands north of Saipan and transported to Saipan, where they are sold for about $55 each. The extent of this activity is not known.

Public Education

The DAWR took delivery of 30,000 copies of a full color fruit bat poster in December. Funding for the printing of the poster came from the Coastal Management Program, Guam Bureau of Planning, and the National Oceanic and Atmospheric Administration.

Fruit Bat Imports

The signing of Palau's Compact of Free Association on 1 October ended all legal exports of fruit bats to Guam and the CNMI (Wiles 1994). Because Palau's subspecies of fruit bat, *P. mariannus pelewensis*, had been placed on Appendix I of CITES in 1989, a total ban on exports to the U.S. was required under CITES. Only one legal shipment of bats was allowed to enter Guam from Palau in FY95. It contained 20 animals on 5 October, and occurred because the owner possessed a valid Guam import permit and a Palauan certificate of origin, both of which had been issued in September 1994 before the ban and were honored by officials.

Surprisingly, customs authorities on Guam did not confiscate any illegal shipments of fruit bats in FY95, and only four shipments were seized upon entry into Saipan, as follows: 5 bats from Palau on 11 November, 6 bats from Palau on 21 December, 93 bats from Pohnpei on 30 December, and 1 bat from Palau on 22 August (R. Born, pers. comm.). The lack of seizures on Guam from shippers ignorant of the ban can be largely attributed to the fact that both the DAWR and Republic of Palau immediately stopped issuing import and export documents for bats on 1 October. This action was important because it informed prospective importers of the ban before they purchased bats and sent them to Guam.

Fears that termination of bat imports would result in increased smuggling of bats from Palau and other neighboring islands (Wiles 1994) appeared to be justified. There were several second-hand reports of continued importations of bats to Guam during the year, although none of the people who gave the accounts could provide any detailed information. The most interesting report came from a Palauan student at the University of Guam in April, who said that he'd heard some of his Palauan friends speak of bat shipments continuing to enter Guam with some regularity.

There was no strong public outcry to the shutdown of bat imports on Guam in October, however, the DAWR did receive a few complaints from importers who were no longer able to obtain import certificates. This may indicate that a few bats are still available to the public through illegal sources.

Surveys for Sheath-tailed Bats in the CNMI

Two trips to Aguiguan were made to conduct surveys of sheath-tailed bats on 21-27 March and 30 June-7 June. A total of 84 caves of various sizes were found during the surveys, 76 of which could be entered to look for bats. A total of 99-101 bats were recorded during the trips. Small colonies were found at five caves, as follows: East Black Noddy Cave and an adjacent clifftop hole, 74 bats; Guano Cave, 17 bats; Cliff Cave, 6-8 bats; Crevice Cave, 3 bats; and Pillar Cave, 2 bats.

Twenty caves appeared large enough to be suitable for sheath-tailed bats, but contained no definite evidence of occupation (i.e., presence of animals, high-pitched calls, guano on walls and floor away from swiftlet areas, and appropriately shaped pellets of guano typical of insectivorous bats) during daytime visits. Fifty-one caves that were small to medium-sized showed no bat evidence; these were generally low rock overhangs, narrow

vertical crevices, and various holes located mostly at the bases of cliffsides or underneath large boulders. Researchers also examined 21 hollow tree trunks (20 *Pisonia grandis*, 1 *Psychotria mariana*), but found no sign of use by roosting animals.

Sheath-tailed bats emerged from caves in early evening about 10-20 minutes before most swiftlets arrived. Bats were observed foraging at three locations in limestone forest, with initial feeding taking place in the last remaining daylight before darkness.

Observations from these surveys suggest that sheath-tailed bats are at best, uncommon on Aguiguan and that a very rough population estimate might be about 150-300 animals. Although good coverage of the island's inland cave system was achieved, coverage of the coastal cliffs that ring the island remains rather poor. The large number of unoccupied inland caves suggests that the availability of roosting caves does not limit the population. A final report will be prepared in FY96 to describe the survey results in detail.

RECOMMENDATIONS

1. Survey bat numbers and distribution along Guam's entire northern cliffline once or twice annually. Searches for additional colonies may be productive because continued poaching at bat roosts on Rota can cause large numbers of bats to move to Guam (Wiles and Glass 1990).

2. Continue observations at Guam's bat colonies. Information on reproductive biology, behavior, and social organization will be used to supplement data already gathered.

3. Summarize data previously collected and write reports on the diet, reproduction, and amount of snake predation on fruit bats.

4. Conduct a study of the vegetation, terrain, and proximity to development of known roosting sites to determine what site characteristics are important in the selection of roosting sites by fruit bat colonies.

5. Known bat roosting and foraging areas should be patrolled regularly by DAWR conservation officers. Part of their effort should be aimed at maintaining a visible presence at Jinapsan and Pajon Points, where poaching has been a serious problem in previous years.

6. Continue to assist the CNMI as needed, with island censuses and other biological studies. Studies conducted on Rota would be most valuable for understanding the aspects of Guam's fruit bat population.

7. Continue to monitor illegal fruit bat imports entering Guam.

PROGRAM COST

The estimated cost of the technical assistance project under W-1R-3 is $28,000.

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Report prepared by: Gary J. Wiles

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: W-1R-3
SUB-PROJECT NO.: W-5
STUDY NO.: 1
JOB NO.: 4

JOB TITLE: Roost Site Characteristics of Marianas Fruit Bats

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

No significant effort was expended on this job during this segment.

Report Prepared by: Gary J. Wiles

PROGRESS REPORT
COORDINATION PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: W-1R-3
SUB-PROJECT NO.: W-6
JOB NO.: 1

JOB TITLE: Technical Guidance to Projects Affecting Guam's Wildlife Resources (1210)

PERIOD COVERED: October 1, 1994 to September 30, 1995

BACKGROUND

The Wildlife Section professional staff of the Division of Aquatic and Wildlife Resources (DAWR) devoted a significant percentage of their time and effort to technical assistance. The pace of development on the island is requiring increasing amounts of time from the Section's staff to fulfill its statutory responsibility to review and comment on development plans, rezoning applications, and various permit applications most of which are local Government of Guam or private sector. In addition, the Section also provides comment and review of numerous activities and proposals from the military bases on Guam that may affect Guam's endangered species and wildlife resources and their habitat. Often this includes commenting on U.S. Fish and Wildlife Service (USFWS) Section 7 consultations concerning impacts of military projects on endangered species. Because of the size and complexity of some of these developments, the Section's review responsibility will require a continuing commitment that often extends beyond project completion.

The professional staff in the Wildlife Section provide technical support to the Division's technical assistance program staff and often take the lead in the review of projects involving their particular expertise, such as those that may have endangered species impacts or those involving wetlands. This effort is extremely important for the management and conservation of Guam's natural resources.

OBJECTIVES

1. To minimize adverse environmental impacts resulting from the construction of recreational, commercial, residential, industrial, military, or public utility facilities.

2. Provide technical assistance to military and civil agencies relative to the management and protection of Guam's wildlife resources.

FINDINGS

Wildlife Section staff have been actively involved in the technical guidance function during this segment. Numerous development plans, impact statements, and permit applications, which were submitted to the DAWR for review, required the Wildlife Section's review. Field investigations and meetings with responsible agencies have been conducted in many cases as a part of the review process.

Various Section staff members actively serve as members of the following groups:

1. Region IX Regional Response Team - Oceania

2. Fish and Wildlife Natural Resource Committee - Andersen Air Force Base

3. Pacific Islands Recovery Team for Birds and Bats, USFWS

4. Captive Breeding Working Group, USFWS

5. Area Committee for Oil Spills

Members of the Wildlife Section have attended numerous meetings and hearings pertaining to the protection of Guam's natural resources and have actively consulted with various civil and military agencies on environmental matters. Section staff maintain close liaison with the Department of Parks and Recreation, Guam Bureau of Planning, Guam Environmental Protection Agency, University of Guam, U.S. Army Corps of Engineers (ACOE), USFWS, U.S. National Marine Fisheries Service, U.S. Navy, Coast Guard, and Air Force regarding matters of environmental concern. In addition, staff members actively consulted with numerous off-island visitors, representing various agencies and organizations, who visited during the segment.

Wildlife Section staff Biologist's III Gary Wiles and Celestino Aguon participated in a USFWS Pacific Islands Recovery Team meeting on Rota in December 1994. Mariana Islands endangered species recovery efforts were the focus of the meeting.

The Wildlife Section assisted the USFWS in holding a Pacific Avifauna Recovery Coordinating Committee annual meeting on Guam in January 1995. Participants attended from Guam, Hawaii, the Commonwealth of the Northern Mariana Islands, and Washington, D.C. While many Pacific ecoregion endangered species recovery efforts were reviewed, the emphasis was on Mariana Islands issues.

Considerable public contact was maintained by Section staff during the reporting segment. In addition to occasional interviews on radio, television, and in newspapers, staff members gave talks to a number of civic groups, sportsman clubs, and school and university classes.

Some more specific Technical Assistance activities of the Wildlife Section included:

1. Continued to participate with Guam Environmental Protection Agency, the Department of Education, USFWS, and ACOE to resolve wetland mitigation issues associated with the construction of the Southern High School in Agat.

2. The Division was represented on the Development Review Committee by its technical review staff, which met bi-weekly to review applications for rezoning, variances, and various types of development. The Division's input at this level is very important in ensuring that the protection of Guam's fish and wildlife resources be considered in land use planning. Wildlife professional staff provided significant technical input into this review process at various levels on numerous occasions.

3. The Division reviewed and commented on ACOE applications for wetland fill. Mitigation recommendations were often included in these comments. Comments and concerns were also provided to various local agencies. Wildlife staff provided significant input into the responses for these applications. Endangered species were of primary concern to the Section with Mariana common moorhens found in most wetlands on Guam.

4. The Section provided technical support to the Division's enforcement staff by identifying and evaluating wildlife, testifying at court hearings, and recommending disposition for confiscated wildlife.

5. Section staff provided technical assistance to the Department of Agriculture's Plant Protection Quarantine Division by identifying confiscated wildlife and wildlife products, holding wildlife in quarantine, and in general supporting their efforts at preventing illegal imports of wildlife to Guam.

6. The Division reviewed and commented on numerous Environmental Impact Statements/Assessments of proposed developments particularly when wildlife issues were present. These comments included recommendations for grading and clearing, erosion control, project design and orientation. These recommendations were made to reduce and/or eliminate impacts to the immediate and adjacent environments.

7. The Division's Wildlife Section provided comments at the request of the USFWS for numerous Section 7 Consultations under the Endangered Species Act, including the following:

    a. Several construction projects at U.S. Naval Magazine Guam.
    b. Numerous military training exercises at AAFB and Naval bases on Guam.
    b. Several wetland related development activities for civilian and military projects.

8. The Section reviewed and commented on several legislative bills that would affect wildlife.

9. The Section responded to many requests for information on laws and regulations pertaining to fish, wildlife, endangered species, hunting and fishing, and importation of wildlife.

10. The Section responded to numerous public requests for information on native wildlife, particularly endangered species.

11. The Section answered numerous requests for information on hunting from both on and off-island individuals. Specific requests included information on hunting areas, hunter safety classes, firearms regulations, hunting seasons and limits, and laws and regulations.

12. Section staff provided technical assistance to numerous farmers and the Air Force and Navy regarding pig damage. Damage control permits requests were evaluated and issued when warranted.

13. Section staff reviewed wildlife-related manuscripts for professional journals. One of our staff is an editor for the University of Guam's journal "Micronesica" and in this capacity reviewed several articles for publication.

14. Section staff assisted in presented hunter safety briefings at Anderson Air Force Base and the Mangilao Community Center to provide pertinent information to hunters.

15. Section staff made numerous presentations on fish and wildlife resources at meetings of numerous and other organizations during the year.

16. Section staff prepared numerous press releases to keep the public informed of fish and wildlife issues including hunting and hunting seasons, brown tree snake issues,

fish and wildlife laws and regulations, endangered species, fish and wildlife importation, etc.

17. Technical assistance and logistic support was provided to various USFWS and National Biological Survey personnel working on the brown tree snake problem both on Guam and in the mainland U.S.

18. The Section staff, at the request of numerous developers, met with them, their consultants and other government representatives to discuss proposed development projects and their potential impacts on endangered species, wetlands and native habitat as well as erosion, project design, etc.

19. Section staff provided technical assistance to USFWS and National Marine Fisheries Service law enforcement personnel on various matters including the importation of endangered species items.

20. Technical advice on wetland issues have been provided to the Development Review Section at the Guam Environmental Protection Agency.

21. Section staff participated in the Navy Installation Restoration Program by providing information to Navy consultants, accompanying them on several site visits, and attending public meetings.

22. The Section's staff continued to spend considerable time assisting in the USFWS's Section 7 review of Navy ARC-50 proposal for flight patterns over endangered Mariana Crow territories at Andersen Air Force Base in Northern Guam. This years' efforts focused on reviewing the draft report.

23. Section staff participated in an evaluation of HC-5 helicopter flight patterns to be flown at the U.S. Navy's Fena Lake during fire fighting training and pilot certification. Flight patterns were developed that would have minimal impacts on the endangered species found at Fena Lake.

24. Staff gave visiting lectures for various University of Guam biology classes on wildlife related topics.

25. Section staff assisted the military in planning field training exercises at various military bases on Guam so that endangered species and their habitat and other wildlife resources would be minimally impacted. Military units involved included:

    a. Guam-based Navy Seals.

    b. Guam National Guard.

    c. Various Air Force units.

    d. U.S. Army units from off-island.

    e. Air National Guard.

    f. University of Guam Army ROTC.

    g. Various DOD special operations units.

h. U.S. Army Reserves.

i. U.S. Navy carrier air units detached to AAFB for exercises.

26. Section staff on numerous occasions met with representatives of the press to discuss wildlife issues the media was interested in. Contact was made with the following organizations:

a. Pacific Daily News, Guam

b. KUAM TV News, Guam

c. Guam Cable TV News

d. KGTF public radio, Guam

e. K-57 radio news, Guam

f. New York Times

g. British Broadcasting Corporation, London

RECOMMENDATIONS

Continue technical assistance activities in support of the conservation of Guam's wildlife.

PROGRAM COST: The estimated cost of the technical assistance project under W-1R-3 is $52,000.

Report prepared by: Robert Beck

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-10
STUDY NO.: 4
JOB NO.: 1

STUDY TITLE: Captive Breeding of Endangered Native Birds

JOB TITLE: Captive Breeding of Endangered Native Birds (1480)

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

The number of Guam rails at the Division of Aquatic and Wildlife Resources' (DAWR) captive breeding facility was 54, as of 30 September 1995. Sixty Guam rails were transferred to Rota and released. Nine pairs of rails were set up for breeding, however, only five pairs produced a total of 18 chicks, which lived for at least 30 days. Two chicks died after 30 days of age, netting 16 chicks for FY95 and there were no adult mortalities. One Mariana crow chick was hatched in the incubator/hatcher in the wildlife lab. The crow chick was hand-reared for two days, then returned to its nest in the wild. As of 30 September 1995, there were 55 Micronesian kingfishers in captivity, including nine offspring hatched in FY95. An action plan meeting was held in Washington D.C. in May 1995 to make recommendations for the Micronesian kingfisher Species Survival Plan (SSP). One of the primary recommendations made was to consolidate the kingfishers in fewer zoos. Consequently, the number of zoos participating in the kingfisher program was reduced from 19 to 8.

BACKGROUND

The Guam Native Forest Bird Captive Breeding Program began in 1983 as a cooperative effort between the DAWR, member zoos of the American Association of Zoological Parks and Aquariums (now known as the American Zoo and Aquarium Association, or AZA) and the U.S. Fish and Wildlife Service (DAWR 1983, Derrickson 1986, Shelton 1986). Predation by the brown tree snake, *Boiga irregularis*, now believed to be the single most important factor in the recent drastic decline of Guam's native forest birds (Savidge 1986, 1987; Conry 1988), precipitated the need for a captive breeding program when, by 1982, at least five species of Guam endemic species or subspecies were nearing extinction in the wild. Unfortunately by 1984, attempts at captive breeding three of these species, the bridled white-eye, *Zosterops c. conspicillata*, rufous fantail, *Rhipidura rufifrons uraniae,* and the Guam flycatcher, *Miagra freycineti*, were abandoned due to their disappearance from the wild (DAWR 1984).

The Guam rail, *Rallus owstoni*, and Guam subspecies of the Micronesian kingfisher, *Halcyon c. cinnamomina,* were successfully brought into captivity (DAWR 1983-86), with the capture of 19 and 31 wild birds, respectively. Rails first bred at the DAWR's facility on Guam and at the CRC of the National Zoological Park in 1984. Dr. Scott Derrickson, Conservation and Research Center, National Zoological Park, Smithsonian Institution, Front Royal, Virginia, continued as coordinator for AZA's Guam rail program. By November 1993, more than 360 Guam rails were produced in captivity.

Reproduction of Mariana crows in the wild continued to be low despite intensive protection against snake predation. Consequently, a plan was devised to initiate avicultural intervention, which will include artificially incubating eggs, fostering chicks back into wild nests, and potentially puppet-rearing chicks for release back into the wild. All appropriate information from the Olinda Endangered Species Propagation Facility and the Peregrine Fund egg house and field aviary in Hawaii was obtained to conduct the avicultural activities with the Mariana crow.

Kingfishers were first bred in 1985 at three mainland U.S. zoos (Bronx Zoo, Philadelphia Zoo, and the Conservation and Research Center of National Zoological Park). During FY88, the first studbook for the Micronesian Kingfisher was published by the Philadelphia Zoo (Bahner 1989). The kingfisher has been designated as a SSP species by the AZA. Beth Bahner of the Philadelphia Zoo was designated by the AZA as studbook keeper. The kingfisher program has been relatively successful, as 17 of 29 founders produced descendants (the last previously underrepresented living founder sired offspring in 1994), and the population reached a peak of 62 individuals in August 1990. However, problems such as high chick mortality, high young adult mortality, aggression, and infertility continue to limit population growth.

OBJECTIVES

Implement and manage captive breeding programs for the Guam rail and other endangered endemic birds by setting up facilities on Guam and at zoos on the mainland U.S., through the AZA. Produce enough Guam rails for release and establishment of an experimental wild population on Rota, Commonwealth of the Northern Marianas (CNMI). Enhance reproductive output of Mariana crows in the wild using avicultural support. Become more administratively active in the management of captive Micronesian kingfishers.

PROCEDURES: Guam Facility

1. Develop plans for and construct seven steel-framed, 12-stall holding aviaries to replace existing wooden aviaries, which have deteriorated from weather and typhoons. Add additional holding aviaries as the need arises.

2. Continue the routine maintenance and operation of a cooperative captive breeding program for the Guam rail and Micronesian kingfisher with the AZA and its member zoos.

3. Develop techniques for the successful release of captive-reared birds in the wild once the factors responsible for their decline have been controlled.

4. Continue to consult with recognized authorities regarding captive breeding methodology, facility designs, and captive population management techniques.

5. Consult and coordinate USFWS, U.S. Department of Agriculture, and other government agencies with jurisdiction over the interstate movement and captive maintenance of wildlife. Acquire all necessary local and federal permits.

6. Breed rails in sufficient numbers to support the continuing introduction of the Guam rail to Rota, CNMI, which began in 1990.

7. Maintain regular contact with the Micronesian kingfisher studbook keeper and make recommendations to the SSP.

8. Coordinate efforts between field and laboratory for manipulating nests, eggs, and chicks of Mariana crows in the wild.

RESULTS

The number of Guam rails at the DAWR captive breeding facility decreased from 99 to 55 from 1 October 1994 to 30 September 1995, primarily due to the release of 60 birds on Rota in FY95 and the production of 16 viable offspring. A total of 34 chicks hatched, of which 16 survived. There were no adult rail deaths during FY95. Death by aggression was eliminated by using mate choice techniques and by observing rails through a blind during introductions for breeding.

A Humidaire incubator and hatcher were set up in an incubator room at the wildlife lab. Eleven eggs were pulled from nests of Mariana crows in the wild and candled to determine viability. Three eggs were incubated, however, only one hatched; one egg was crushed in the nest during the latter part of parental incubation and another egg was infertile. The hatched crow chick was hand-reared for two days following the Alala, *C. hawaiiensis*, protocols, and fostered back into its nest in the wild. Unfortunately, it was found dead on the ground beneath the nest when it was 11 days old. It apparently died from a fall. Why or how it fell from the nest could not be determined.

Micronesian kingfishers continued to be captive bred at 19 mainland U.S. zoos (Bahner 1993). The stateside captive population numbered 55 by 30 September 1995, including 9 chicks which hatched in FY95. However, it has continued to decline since a peak of 62 kingfishers in August 1990. The program continues to be plagued with problems such as aggression, infertility, nutritional concerns, and adult mortality. In May 1995, the AZA sponsored an action plan meeting in Washington D.C. which was attended by essential persons from the zoo community involved in the captive breeding and management of the kingfishers, DAWR, USFWS, National Biological Survey, National Audubon Society, Environmental Defense Fund, and other interested individuals including journalist Mark Jaffe and student Robert Cummings. The two-day conference examined critical aspects of the kingfisher management program and culminated in recommendations for action, including the consolidation of kingfishers in fewer zoos to facilitate standardization of husbandry protocols, mate choice, and the collection of data for research. DAWR agreed to become more involved with the management of the Micronesian kingfishers by providing the initial screening of 46 adult kingfishers for avian tuberculosis through Dr. Susan Clark of the University of Wisconsin.

Consultation with the engineering design section of the Department of Public Works continued in order to develop plans for the construction of new steel Guam rail aviaries. However, tentative plans by the Government of Guam to move the Department of Agriculture to a new location may delay this effort to improve the Guam rail captive breeding facility.

RECOMMENDATIONS

1. Continue the routine maintenance and operation of a cooperative captive breeding program for the Guam rail and Micronesian kingfisher with the AZA and its member zoos.

2. Construct additional 12-stall wooden holding aviaries as needed to support the Rota release of rails. Develop plans to relocate the existing rail facility to the new Department of Agriculture site.

3. Develop plans and funding for the construction of a building at the new Department of Agriculture site to support food preparation areas, incubator and brooding equipment usage, and storage of supplies and equipment.

4. Continue to consult with recognized authorities regarding captive breeding methodology, facility design, and captive population management techniques.

5. Assist in the design of appropriate veterinary facilities at the new Department of Agriculture site in order to upgrade support for the Division's captive breeding program.

6. Consult and coordinate with USFWS, U.S. Department of Agriculture, and other government agencies with jurisdiction over the interstate movement and captive maintenance of wildlife and to acquire all necessary local and federal permits for shipment of rails between Guam and mainland U.S. zoos.

7. Breed rails in sufficient numbers to support the continuing introduction of the Guam rail to Rota, CNMI, which was begun in December 1989.

8. Coordinate with Dr. Scott Derrickson, Conservation and Research Center, National Zoological Park, Front Royal, Virginia, to convert the Division's Guam rail records system to that used by member zoos of the AZA. This will facilitate a more efficient coordination of record keeping between Guam and mainland U.S. zoos.

9. Continue avicultural intervention of Mariana crows and support Division efforts to increase production crows in the wild by snake-proofing nest sites.

PROGRAM COSTS

The estimated cost of the captive breeding program during FY95 is $125,000.

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Report prepared by: M. Kelly Brock and Robert E. Beck, Jr.

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-10
STUDY NO.: 4
JOB NO.: 2

STUDY TITLE: Captive Breeding of Endangered Native Birds

JOB TITLE: Development of an Experimental Population of Guam Rails in the Commonwealth of the Northern Mariana Islands (1311)

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

Sixty Guam rails were released on Rota in FY95: 15 in March, 30 in August, and 15 in September. A biologist II was hired in June to assist with the rail releases. Extensive efforts were made to remove predators from the release area prior to the August and September releases after six birds from the March release were preyed upon within three days after release. Twenty-seven rails were instrumented with radio transmitters. The longest known survivor was last tracked 50 days post-release. Seventeen rails were confirmed dead. Eight cases of predation (primarily by feral cats) were confirmed, one case of septicemia was confirmed, and the cause of death of the remaining eight birds was unknown. Six radio transmitters emitted mortality signals from over the cliffs in the Sagua'gahga seabird colony, and it was assumed that five of those rails were dead. In late September, problems with telemetry equipment rendered further monitoring difficult. Rails continued to use supplemental feeding stations near the release site, making visual observations from blinds possible. Seven rails (5 non-instrumented) were recaptured in live traps set for rats and feral cats, which facilitated post-release monitoring of rails. The general condition of released rails was assessed by comparing body weights of recaptured rails to pre-release weights. All recaptured rails seemed in good nutritional condition. Guam rails were known to be surviving in the release area beyond 30 September 1995.

No Guam rails from previous releases in 1990 or 1991 were observed on Rota in FY95, although there were several unconfirmed reports of rails seen by local people in the vicinity of the Coconut Village Hotel about halfway between the airport and Songsong village. Another unconfirmed sighting of a Guam rail at the Tagastone quarry in May 1995 was reported to the Special Assistant to the Secretary of the Department of Lands and Natural Resources on Rota.

BACKGROUND

Since the creation in 1960 of the Guam Division of Aquatic and Wildlife Resources (DAWR), census data from roadside counts, station counts, and transect counts have documented the reduction in range and numbers of the Guam rail, *Rallus owstoni,* and other native birds (DAWR 1961-1987; Jenkins 1983; Engbring and Ramsey 1984). Predation by the brown tree snake, *Boiga irregularis*, is believed to be the major factor contributing to recent declines in native bird populations (Savidge 1986, 1987; Conry 1988).

A captive breeding program for the Guam rail successfully began in 1983 on Guam and at mainland U.S. zoos in cooperation with the American Association of Zoological Parks and Aquariums (presently known as the American Zoo and Aquarium Association or AZA) (DAWR 1984-1987; Derrickson 1986). Guam rails were first brought into captivity in 1983 on Guam and bred at the DAWR's rail facility in the spring of 1984 (DAWR 1983-4).

The DAWR developed plans to introduce the Guam rail to Rota in order to develop a self sustaining wild population of rails that will not undergo domestication from captive breeding. It was hoped that the experience gained in introducing the rails to Rota will provide valuable information useful for future introductions on Guam. The Rota population may also serve as a partial source of birds for use in reintroducing the rail to Guam when snake predation has been controlled there.

During FY87, a cooperative agreement was signed between the Government of Guam, Commonwealth of the Northern Mariana Islands (CNMI), and the U.S. Fish and Wildlife Service (USFWS) outlining the responsibilities of each entity for the introduction. An environmental assessment was prepared for the USFWS covering the introduction of the Guam rail to Rota. The DAWR reached an informal agreement with Dr. Stuart Pimm, University of Tennessee, by which a graduate student would reside on Rota to monitor the initial two rail introductions in cooperation with the DAWR as a part of his dissertation research. Dr. Pimm was successful in receiving several grants from international conservation organizations to support his efforts in monitoring the introduction on Rota.

After a permit to establish an "experimental population" of Guam rails from the captive population was published by the USFWS in the Federal Register (USFWS 1989), 22 Guam rails were released at the first site on the Sabana on Rota in December 1989 and January 1990 (Fig. 1). All but one rail were released with radio transmitters attached in order to monitor their dispersal, mortality and possible breeding success. Of the 22 released birds, the whereabouts of 9 were unknown as their radios failed, 4 were killed by vehicles, 2 were killed by cats, 2 apparently died of starvation, 1 died of poisoning, and 4 died of unknown causes (DAWR 1991, Witteman et. al. 1991).

The forest edge of Puntan Sagua'gahga in I Chiugai was chosen as the site for the second release of Guam rails on Rota (Fig. 1). On February 4, 1991, 31 rails were released at the forest edge in I Chenchon Park near the Bird Sanctuary Overlook (Witteman and Beck 1991). This release appeared to be more successful than the January 1990 release at the Sabana. Graduate student Greg Witteman returned to the University of Tennessee in the spring of 1991, after the second release, to complete his graduate work.

METHODS

The same area at I Chiugai where were rails released in 1991 was selected for the 1995 releases, with the exception of releasing rails deeper in the forest (Fig. 1). A 1.75-km-long trail dissected the Puntan Sagua'gahga and Puntan As Fani forests. The *release area* was a 60,000 square meter corridor of forest between the two Puntans. Introduction cages were located directly in the center of the release area and were designated as the *release site*. The *immediate release area* was designated as 10,000 square meters (100 x 100 m) around the release site, based on the area occupied by Guam rails around the introduction cages. The release area was bounded north and south by limestone cliffs, and included width space of approximately 200-400 m of forest.

On 27 March 1995, 51 snap traps, 16 live traps for rats, and 5 live cat traps were set around the release site two days prior to the release of Guam rails. The traps were set to remove predators that may have been attracted to rails in the introduction cages. The cat

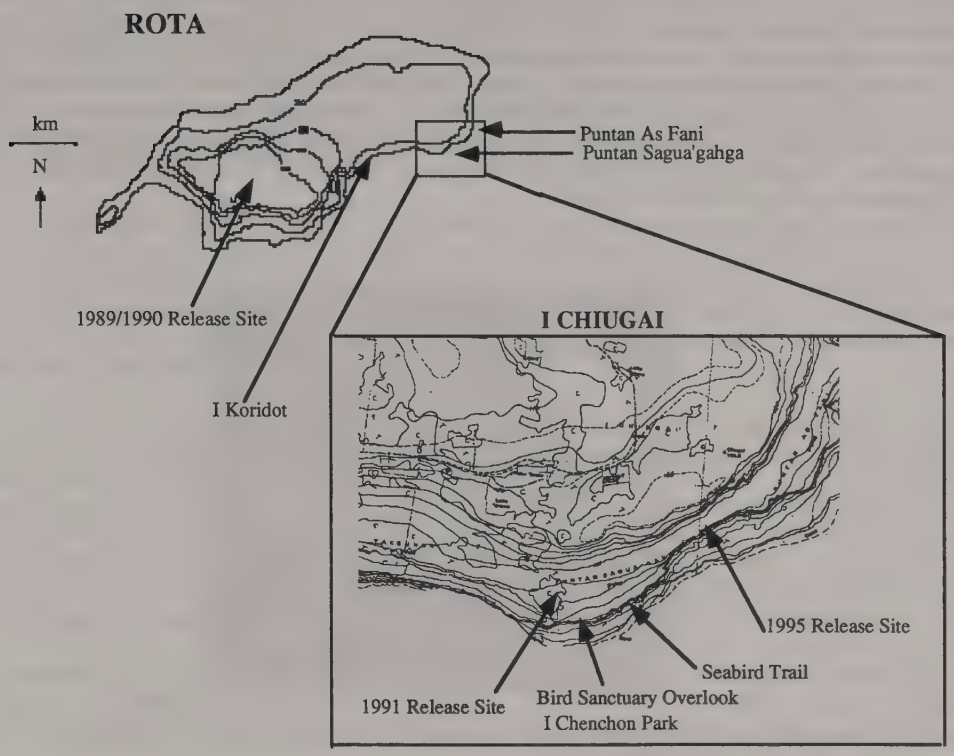

Figure 1. Topographic map of I Chuigai (inset) Rota, CNMI. In 1995 , Guam rails were released in the narrow strip of forest between Puntan Sagua'gagha (west) and Puntan As Fani (east).

traps were moved a week later into the forest surrounding the introduction cages, where it seemed apparent that feral cats were hunting. On 5 July 1995, more intensive measures were initiated to remove predators from the release area three weeks prior to the release of rails in August and September. Forty-four snap traps, 16 live rat traps, and 17 live cat traps were placed along a transect that dissected the release area (basically along the trails and about 50-100 m in the forest parallel to the Old Japanese Road). Five more cat traps were placed around the release area on 20 August, and five additional live cat traps were placed around I Chenchon Park. Rats were trapped around rail supplemental feeding stations for control purposes and for use as bait in cat traps. Canned cat food was also used as cat bait, and a mixture of peanut butter and oatmeal was used as rat bait. After the first two cohorts of rails were released in March and August, the use of 19 snap traps was discontinued in the immediate release area to avoid injury to or death of rails. The remaining snap traps were set in the evening and closed in the morning. Live traps were set for capture all day as monitor lizards were also targeted for capture. No forest birds were ever caught in either snap traps or live traps, with the exception of feral chickens in live traps.

The release methods for the 1995 introductions to Rota were modified from methods used in the previous introductions. Fifteen introduction cages, 4' W x 4' L x 2' H were constructed in the forest and lined up along the trail at the introduction site. The cages were about 3-4 feet apart from each other, and were made of 1.5" X 1.5" wood and 1/4" mesh hardware cloth. Each cage was bottomless and sat flush to the ground with rocks, dirt, and leaf litter piled up around the perimeter to keep predators out. A small wire door was made on the top of the cage for placement of the rails, food, and water inside. Guam rails arrived on Rota two days prior to release via commercial airplane. The birds were transferred to the introduction cages (one bird per cage) and held for two days to acclimate to the sights and sounds of the forest. Sixty rails (30 males and 30 females between the ages of 1 and 6 years) were released in four groups of 15 on 29 March, 2 August, 9 August, and 20 September. The rails were released from the cages by lifting the introduction cage and letting the bird run or walk out (Fig. 2).

Figure 2. Guam rails were released from introduction cages by lifting the bottom and allowing the rails to run or walk out into the forest.

A total of 27 rails were instrumented with radio transmitters: 5 in the March release, 17 in the August releases, and 5 in the September release. Supplemental food stations were set up around the introduction cages and in the release area where rails seemed to settle. Data were collected on survivorship, mortality, dispersal, supplemental feeding, and behavior.

RESULTS

The 15 Guam rails released on 29 March suffered heavy mortality from predation in the immediate release area within the first three days of release. Six rails were confirmed dead by 1 April. Five of those rails were preyed on by feral cats, and the sixth rail was found dead with a broken leg in a crevasse below the release area. Because of the immediate losses, the release of a second group of 15 rails scheduled for 5 April was canceled. One feral cat and one monitor lizard were captured in April at two of the rail kill sites, but their stomach contents contained no evidence of rails. The status of one instrumented rail was unknown as the radio signal was lost two days after release. The status of the remaining non-instrumented eight rails was unknown. No further data were available on these birds.

When pre-release trapping was conducted in July, three cats were caught in the first 10 days of trapping (following four days of pre-baiting) in the release area. In all, 10 cats, 8 monitor lizards were captured between 10 July and 30 September 1995. The removal of

predators in the release area allowed for greater survivorship of released rails and the collection of dispersal, supplemental feeding, and behavior data in August and September.

Survivorship and Mortality Factors

As of 30 September 1995, three of the 45 rails released in August and September were known to still be alive. Two of the surviving rails were instrumented with radios emitting intermittent signals -- by the end of September radio signals started to weaken -- and the non-instrumented third rail was observed at a supplemental feeding station. Other rails were known to be in the release area as evidenced by the use of supplemental food stations (see section on supplemental feeding below), however the status of most non-instrumented rails was unknown.

Eleven rails were confirmed dead. Two cases of predation were confirmed (probably by feral cats), five rails went over the cliffs, and one died from an illness (impacted egg and resulting septicemia). The remaining three rails died from unknown causes; only feathers or partial remains were found. Four rails dropped their transmitters when the harnesses broke. Their status was unknown as there was no sign of a carcass or a kill. Six rails were lost as their radio signals faded.

Five non-instrumented rails and two instrumented rails were caught in live rat and cat traps, five to 36 days after release. These captures were unexpected but welcomed as a means to monitor survivorship and dispersal of non-instrumented rails. Three rails were caught more than once. Six rails were captured within 100 m of the release cages while the seventh was captured about 400 m to the west of the cages. (Traps extended east and west well beyond the release area). Three rails were weighed to assess body condition as an indicator of foraging success. All three recaptured rails lost some weight, but were still in the normal body weight range for Guam rails in captivity at DAWR (200-260 g).

The earliest known mortality occurred within 3 days of release, while the longest known survivor had lived 50 days as of 30 September. Guam rails were known to be surviving beyond 1 October 1995 in the release area.

No long term survival was apparently achieved with the early releases of Guam rails, as no rails have been sighted or heard since the spring of 1991. However, in early 1995, the Mayor of Rota reported a sighting of what he and his assistant thought was a Guam rail on the main road near the entry to the Coconut Village Hotel. A second sighting was reported by another individual, of two Guam rails near the swimming hole in the vicinity of the Coconut Village Hotel. Neither report could be confirmed by CNMI, USFWS, or DAWR biologists. A farmer living along the main road near the first sighting was interviewed. He had heard of the sightings but had not seen rails in the area himself.

Dispersal

Only 21 of 22 rails instrumented in the August and September releases were followed by radio telemetry. One radio failed to emit signals upon the release of the rail. Documentation of non-instrumented rails remaining in the release area was made by visual observations at supplemental food stations or by recapturing rails in live traps.

Of 27 rails whose movements were monitored, 12 (44%) stayed within the release area. Of those rails in the release area, 11 stayed within 100 m of the release site.

Nine rails moved out of the release area almost immediately after release, and within three days were outside of the release area. Four rails headed northeast into Puntan As Fani,

while five rails moved down the south slope of Puntan Sagua'gahga and dispersed towards I Chenchon Park (Fig 1). One of those rails continued to disperse out of the forest, following the roads that traversed open fields to the west and settled in the forest of I Koridot (Fig 1), approximately 2 miles from the release site.

Six rails stayed in the release area for more than 3 days (almost seeming to settle) before moving out of the release area. One rail moved east into Puntan As Fani, while five dispersed towards I Chenchon Park. Of the 15 rails that were known to disperse from the release area, 10 (67%) moved down the southwest slope of Puntan Sagua'gaha to I Chenchon Park (it is curious that rails chose to follow the south slope of Puntan Sagua'gahga and not the relatively level trail out to I Chenchon Park) and five (33%) moved into Puntan As Fani (Fig 1).

Supplemental Feeding and Behavior

Ten supplemental feeding stations were placed where rails apparently settled in the immediate release area. The food (captive diet) was presented in the same manner on Rota as it was in captivity on Guam. Every morning, fresh food was put in a plastic dish under a tent of aluminum and wood to protect it from rain. In the evening, the food was removed to prevent rats from habituating to this food source. As many as eight feeding stations were used by rails (instrumented and non-instrumented), as confirmed by visual observations or the presence of rail footprints in the fine food crumble. Supplemental feeding continued daily from the first day of release (2 August) to well past 30 September. Supplemental feeding continued as long as it was apparent that Guam rails were continuing to return to food stations.

One feeding station was consistently used by a noninstrumented male and an instrumented female, allowing us to build a blind to observe feeding and behavior. These two rails were observed from 15 August (13 days post release) until 1 September 1995, approximately 25 m north of the release cages. On the first day, the male was observed feeding at the station and chasing away the female. However, it was later observed that the female would come in to feed, followed shortly by the male. The male always came from and returned to the same direction as the female. The two were never seen together, except for the earlier incident of a chase. On the evening of 22 August 1995, the rails were heard dueting. There were many indications that this pair of rails may have been nesting, however, no nest was found. On 6 September, the remains of the female were discovered approximately 100 m from the feeding station.

A second set of rails was heard dueting on the same evening as the pair above. This second set of calls immediately followed the first set of calls and came from about 75 m southeast of the first calling rails. The food at the supplement station was consistently eaten by rails at this second site until approximately 24 August (2 days later), when a black cat was seen at the release site.

Two male rails (one instrumented and one non-instrumented) were known to be using the same food station (both were captured in the live traps set near the food station). After two weeks the instrumented rail moved out of the release area, while the noninstrumented rail remained in the vicinity of the food station (as verified by recapture after the instrumented rail left the area). It is unknown why one male left the area, but it is possible the food station was usurped by the other male. Other rails were observed consistently using a particular food station, possibly indicating they defined a territory around the food station.

Food stations were not placed beyond 100 m of the introduction cages. Thus, foraging success of rails that dispersed from the release area did not depend on supplemental feeding.

Conclusion

The August and September releases were more successful than the March release, most likely due to the removal of feral cats in the release area. There was insufficient data at this point to determine if survivorship was affected by dispersal distance or by supplemental feeding. There appeared to be no significant differences in dispersal pattern or survivorship between the sexes. Successful foraging did not appear to be dependent on supplemental feeding, as many rails that moved away from the release site lived as long or short as rails that stayed in the release area and used supplemental food stations. Further, it is unknown how many rails that remained in the release area did not use supplemental food stations. Supplemental food stations may have played more of a role in defining, or defending, territories than in factors related to survivorship. Data on area use by rails (i.e. territoriality) have not been analyzed.

RECOMMENDATIONS

1. Continue to breed Guam rails in captivity needed for the Rota introduction both on Guam and at mainland U.S. zoos.

2. Continue to improve techniques and methods for introduction of the rail to Rota.

3. Continue to introduce Guam rails to Rota.

4. Monitor the release of rails on Rota.

5. Continue to seek funding from conservation organizations to support the monitoring of the introduced rail population.

6. Coordinate with the CNMI Division of Fish and Wildlife (DFW) for the third release and monitoring of rails on Rota.

ACKNOWLEDGEMENTS

Dr. Ann Marshall of the CNMI DFW was responsible for processing all necessary permit applications (research and import) for DAWR, and assisted in trapping predators and monitoring rails for two weeks in August. Her participation in the Guam Rail Introduction Program was invaluable and much appreciated. The DFW staff on Rota was extremely helpful in supplying manpower and vehicles. Conservation officers assisted in constructing the introduction cages and in carrying the rails into the forest. DFW biologists David Worthington and Stan Taisican assisted in various aspects of the program, including transportation and office support. Certificates of Appreciation were given to the Rota DFW staff and Mayor Inos for their contributions to the program. USFWS biologist Daniel Grout provided communication services between Rota and Guam and assisted with monitoring released rails.

PROJECT COST

The estimated cost of the Guam Rail Introduction Program during E-1-10 is $50,000.

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Report prepared by: M. Kelly Brock and Robert E. Beck, Jr.

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-10
STUDY NO.: 7
JOB NO.: 3

STUDY TITLE: Control of Brown Tree Snakes on Guam

JOB TITLE: Development and Implementation of Control Methods for the Brown Tree Snake (1470)

PERIOD COVERED: October 1, 1994 to September 30, 1995

SUMMARY

Field tests of electrical barriers designed to prevent predation at Mariana crow (*Corvus kubaryi*) nests by brown tree snakes (*Boiga irregularis*) continued this fiscal year. Thirteen active crow nests were snake-proofed early in the nest building phase. As a result, 3-egg clutches were recorded for the third year in a row, in addition to 1-egg clutches. Results of a study on the efficacy of electrical barriers indicated that snakes were not able to pass through electrical barriers installed on typical crow nest trees. This is consistent with results from the previous nesting season, which showed no loss of nests to snake predation.

BACKGROUND

Roadside counts by the Guam Division of Aquatic and Wildlife Resources (DAWR) have documented the decline of the native forest birds of Guam (DAWR 1974-1994). Studies by Conry (1988) and Savidge (1986, 1987) indicated that predation by brown tree snake is the main cause of this decline.

Since these studies, attempts to develop effective means of protecting active nests of Mariana crows have been made. Clearing of vegetation in direct contact with the nest tree, snake trapping, use of galvanized sheet metal girdles, and use of the adhesive resin Tangle-Foot ® have all been used as snake barriers around nest trees. The use of sheet metal girdles and Tangle-Foot was partially successful but resulted in the mortality of nest trees and was discontinued. Clearing of vegetation and snake trapping have also met with some success.

Since 1990, active nests have been successfully protected with the placement of electrical barriers on the trunks of active nest trees. A combination electrical barrier and clearing of vegetation around the active nest tree have met with some success (Aguon et al., 1992). Successful protection of active nests in 1992 resulted in the fledging of three crows from two nests (DAWR 1992). These were the first fledglings in the wild since 1985 (Michael 1987).

OBJECTIVES

To develop methods for controlling brown tree snake predation on active nests of native forest birds.

PROCEDURES

1. Field testing and operational installation of electrical barriers.

2. Field testing of the timing of electrical barrier placement in crow nesting trees.

3. A brown tree snake electrical barrier efficacy study, first conducted in 1994, was repeated in June - July 1995. Twenty crow nest trees used during the 1994 and 1995 breeding season were selected for the experiment, which involved two 7-day purge periods followed by 14-day trials. Vegetation around the nest trees had been previously cleared, therefore, very little effort was needed to prepare for testing. For the first trial, 10 trees were randomly selected for the control group where electrical barriers were turned off; 10 trees for the experimental group had their electrical barriers turned on. During the second trial, the conditions were reversed. Where there was more than one tree electrified to protect the nest tree, the setup was considered as one tree. Two snake traps were placed in each tree and continuous trapping was conducted during the 42-day experiment.

RESULTS

Field use of electrical barriers to protect nests of the Mariana crow from brown tree snake and monitor lizard, *Varanus indicus*, predation continued this fiscal year. Electrification of nest trees continues to be important for protecting nests prior to egg-laying.

During the crow-breeding season from approximately November 1994 to March 1995, intensive searches were carried out in northern Guam to locate crow territories and nest sites. Barriers were placed on nest trees during the night as soon as nest building was observed. Battery-powered electrical barriers, some that were equipped with solar panels, were used. Maintenance of the barriers was carried out throughout the nesting season. Trapping for snakes occurred around and in the nest trees. Care and feeding of the mice used as bait in the traps occurred on a regular basis under the cover of darkness, usually hours before sunrise.

Fourteen Mariana crow nests built by 8 pairs of crows were snake-proofed (Table 1). Of these, four failed to produce any eggs, one was probably snake-proofed after the egg(s) were preyed upon, and progress at one nest (No. 295) stopped abruptly when a mate was lost during the nest building period. The remaining bird mated again and the new pair produced two clutches (No. 295B and 311) during the season. For their first clutch, the new pair used the same nest that the old pair had completed (295). Four nesting pairs produced eggs at eight of 13 snake-proofed nests. Seven of these nests were protected early during the nest building phase. At one nest (No. 312), birds had already laid an egg before the nest tree was snake-proofed. The egg was transported, via a temperature controlled brooder box to the DAWR incubation facility, prior to barrier installation. The egg was returned to its nest the following day so that it could be incubated naturally. This egg was later found to be enviable.

During the 1994-95 breeding season, two snake-proofed nests contained 3-egg clutches while 1-egg clutches were found in the remaining 6 nests. Two-egg clutches were not recorded this year.

Table 1. Summary of nests protected with electrical barriers and their outcome. Four other nests (from 2 pairs) were also snake-proofed, but the birds failed to lay eggs. Progress at a fifth nest (295) stopped abruptly when a mate was lost. The remaining bird mated again and continued to use the same nest (295b). One nest (297) was probably snake-proofed after the clutch was preyed on. Eggs were usually candled after the first week of the incubation period.

Pair ID	Nest No.	Tree Species	No. of Snakes	Clutch Size	No. Hatched	Percent Hatched
C1	294	Elaeocarpus	1	3	0	0.0
Area 10	295B	Elaeocarpus	0	1	0	0.0
11B6	301	Elaeocarpus	1	1	0	0.0
Pipeline	306	Ficus	1	1	0	0.0
11B6	308	Elaeocarpus	0	3	0	0.0
C1	309	Elaeocarpus	0	1	1	100
Area 10	311	Elaeocarpus	0	1	0	0.0
Pipeline	312	Ficus	0	1	0	0.0
Area 10	295[a]	Elaeocarpus	0	0	-	-
Pipeline	297[b]	Ficus	1	0	-	-
15B3	313[c]	Elaeocarpus	0	0	-	-
15B3	316[c]	Elaeocarpus	0	0	-	-
WSA	315[d]	Ficus	0	0	-	-
WSA	317[d]	Ficus	0	0	-	-
		Total	4	12	1	8.0

[a]Progress at this nest was stopped abruptly when a mate was lost. A new pair was formed which used the same nest (295B) listed above.

[b]This nest was probably snake-proofed after the clutch was preyed on, based on the behavior of the female.

[c]These nest trees were snake-proofed during the early cup phase of the nest and developed to completion but the pair failed to lay any eggs.

[d]These nests were snakeproofed when nest attendance was diminishing. The adults abandoned soon after the trees were snake-proofed.

Snake-proofing early in the nest building phase allows for the removal of snakes already present in the nest tree prior to placement of the barrier. Snakes were already present at 3 (23%) of the 13 nests that were snake-proofed at night during the nest building phase. This rate is lower that the 48% rate recorded during last breeding season (DAWR 1994).

However, the presence of snakes prior to egg laying further strengthens the need to protect nest trees before crows begin egg-laying. One other nest, which was electrified after incubation had begun, was abandoned soon after the barrier was installed. Inspection of this nest prior to installation of the barrier indicated the absence of any eggs, though the behavior of the adult female indicated otherwise. The eggs of this nest were probably preyed on the night before and this bird was exhibiting residual incubation behavior.

While snake-proofing is important in improving the nesting success of crows, other factors besides snake predation appear to be limiting their reproductive success. Of the 12 eggs produced, 11 eggs (92%) failed to hatch. Of these 12 eggs, 11 were candled between day 7 and 10 of the incubation period; nine (82%) of the candled eggs contained no development (probably infertile) and two were fertile. One fertile egg, which partially developed and failed to hatch, was cracked. This probably resulted in the death of the developing embryo. The one egg (nest #309) that hatched after being artificially incubated at the DAWR incubation facility also contained a crack when removed from the nest. The causes of the egg cracking are unknown, but are probably related to disturbance. Extremely low hatch rates continue to plague the nesting crows on Guam and it is highly recommended that other management techniques be implemented (e.g., translocation of fertile eggs or nestlings from Rota) to improve the reproductive success of these birds.

Though electrical barriers continue be effective in preventing brown tree snake predation on active nests, the barrier is unable to control other factors that might be affecting reproductive success. Nest disturbances by intruder crows were documented at 3 of the 8 nests. This resulted in the pulling of the clutch at one nest, at two other nests the eggs contained cracks, which probably resulted from some disturbance forcing the female to quickly leave the nest. Migratory hawks, seen around a few nest sites, may have also forced crows to leave their nests.

The U.S. Fish and Wildlife Service (USFWS) assisted DAWR this year by providing experienced staff and volunteers. They assisted in the search for active crow nests, snake-proofing, and conducting daily early morning observations at several nests. Dawn-to-dusk nest observations of the C1 nest (#309), which had the only successful hatch of the season, were conducted and could not have been accomplished without this additional support. The single egg from this pair's second clutch was fertile, and hatched after it was removed from the nest and artificially incubated. The nestling was then hand-reared for two days before being returned to its nest. Unfortunately, it was found dead on the ground beneath the nest when it was 11 days old; it apparently died from the fall. Why or how it fell from the nest was not determined.

A snake barrier efficacy study demonstrated the effectiveness of electrical barriers in preventing brown tree predation. Forty-nine snakes were captured in control trees only, for a total of 1,220 trap nights (560 and 560 trap nights for controls and treatment groups, respectively) (Table 2). Snakes were not captured or detected (absence of crushed foils) in treatment trees. Three control trees (15%) failed to record any snakes while electrical barriers were off. In addition, five escapes from traps in control trees were noted, as indicated by crushed foil cylinders placed in the trap as indicators. In one instance, a snake was observed curled up on top of a trap in a control tree and did not enter the trap.

Control trees had a mean of 0.0875 $\pm$ 0.0690 (S.D.) captures per trap night. The mean number of captures per trap night for the first trial was 0.0893 ($\pm$ 0.0811). This was slightly different from the second trial, which recorded 0.0857 ($\pm$ 0.0588) captures per trap night, but was not significantly different ($t = 0.113$, $df = 26$, $p > 0.05$). The first trial recorded an average of 1.79 ($\pm$ 1.48) snakes captured per control tree, which was only

slightly different from the second trial which recorded 1.71 (± 1.14) snakes per control tree ($t = 0.143$, $df = 26$, $p > 0.05$).

Table 2. The number of snakes captured in traps during two 14-day trials of 20 trees fitted with electrical barriers. Trees that were controls (barriers off) during the first trial were treatments (barriers on) during the second trial, and vice versa. Trap rate is the number of snakes captured per trap per night.

		No. of Trees	No. of Snakes Captured	Mean Trap rate	Standard Deviation
Trial 1					
	Control	10	24	0.0893*	0.0811
	Treatment	10	0	0.0	0.0
Trial 2					
	Control	10	25	0.0857*	0.0588
	Treatment	10	0	0.0	0.0

*First and second trials were not significantly different, t-test, $t = 0.0113$, $p > 0.05$ (from Aguon et al., in prep.).

A manuscript discussing the results of this study is currently in preparation and will be submitted for publication in a refereed journal (Aguon et al., in prep.).

RECOMMENDATIONS

1. Conduct laboratory development and testing of techniques for protecting active native bird nests when necessary.

2. Conduct *in situ* tests of nest protection methods, which prove effective in laboratory experiments when necessary.

3. Explore and implement other methods or techniques to improve reproductive success of nesting birds.

PROGRAM COST

The estimated cost of this project under E-1-10 is $100,000.

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Report prepared by: Celestino F. Aguon

ANNUAL REPORT
LAW ENFORCEMENT SECTION

PERIOD COVERED: 1 October, 1994 to September 30, 1995

During FY95, 60 persons were arrested by Conservation Officers (CO's) and charged for violating Fish, Game, Forestry and Conservation Laws. A total of fifty-two individuals were arrested and charged for illegal hunting, including two male minors. Eight offenders were charged for the harvest live coral; undersize Tridacna and Trochus. One individual was charged for harboring a live deer.

Sixty arrest cases have been turned over to the Attorney General's Prosecution office for criminal action. No criminal judgments have been forwarded to the Department since the beginning of the fiscal year.

Out of the sixty arrest cases several individuals were additionally charged as follows: Five for possession of an unregistered firearm; five for possession of a weapon without a valid firearms identification card; two for resisting arrest; one for contributing to the delinquency of a minor; one for possession of control substance; one for fraudulent use of a license plate, and reckless conduct; one for open container; and one for obstructing Government Operations.

It is noteworthy to mention that one additional arrest case was made by the CO's where a follow-up investigation revealed that a weapon involved in an illegal hunting case had been unlawfully transferred to one of the defendants involved in the case, resulting the arrest of the registered owner of the weapon.

At the end of the reporting period, nine vehicles were used in the commission of illegal hunting. Out of the nine vehicles confiscated, seven were released administratively through a mitigation process, resulting the total payment of $1,750.00, to the Department's Wildlife Conservation Fund, and two vehicles are still pending Civil Forfeiture action. One weapon was mitigated administratively for a fee of $100.00, which was deposited into the Wildlife Conservation Fund.

It is note worthy to mention that during this period a meeting was arranged with the Attorney General, Civil Litigation and Criminal Sections where double jeopardy issues were discussed. The Attorney Generals has given notice that a ruling from the Supreme Court will permit them in pursuing both criminal prosecution and civil forfeiture in cases involving illegal hunting. In the past, these cases were tried separately resulting in heavier penalties, but the new ruling would only allow one case be heard to avoid double jeopardy issues. It was also recommended by the Attorney General that the statute be rewarded to cover confiscation as part of a criminal forfeiture.

During this period, numerous weapons and other hunting and fishing paraphernalia from 1994 to 1995 cases were forfeited by court order to the Department for disposition.

Numerous incidents such as spotlighting, fish poisoning, fruitbat poaching and turtle hunting were investigated by CO's that did not result in arrests. In one incident where officers were conducting surveillance on a ranch in southern Guam, the presence of the officers was detected, the lights at the ranch went out, and shots were fired in the direction of the officers. The officers took cover and no injures were sustained.

This incident was reported to GPD Narcotics Division because the CO's based on this observation and previous encounters with the occupants of the ranch, suspected that illegal drug trafficking was taking place.

In some incidents, lack of equipment hindered the officers in making apprehensions. In some cases the suspects were no longer in the area, and in others officers may have confronted suspects made, but made no arrests due to insufficient evidence and warnings were issued. CO's removed several thousand feet of abandoned gill nets in reef and beach areas and properly disposed of them. Field investigation reports of such incidents were submitted and filed for future reference. CO's issued three litter citations for this period.

Report prepared by: Lt. Wayne W. Bigler